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Alberta

MUNICIPAL AFFAIRS

Innovative Housing Grants Program

# AN EVALUATION OF PRESERVED WOOD FOUNDATIONS IN ALBERTA

February 1989

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The views and conclusions expressed and the recommendations made in this report are entirely those of the authors and should not be construed as expressing the opinions of Alberta Municipal Affairs.

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## FOREWORD

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## EXECUTIVE SUMMARY

### INTRODUCTION

Preserved wood foundations (PWF's) have been built in Canada for almost 30 years but have only been built in Alberta since the mid-seventies after the Building Standards Branch of Alberta Labour authorized PWF construction through the issuance of a StanData. This foundation system was later incorporated into the 1980 Alberta Building Code by way of a new StanData. By 1985 the system was fully integrated into the Code as articles 9.15.1.6 and 9.15.1.7. The articles set CAN3-S406-M83. "Construction of Preserved Wood Foundations" as the design and construction standards for PWF's in Alberta.

### OBJECTIVES

While there has been considerable use of PWF's, there has been no systematic attempt to date to investigate, analyze and evaluate their performance. The purpose of this research project was to evaluate the performance of preserved wood foundations built in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate. The detailed objectives of the study were:

1. to carry out a review of published information and to survey key actors in the preserved wood foundation industry,

2. to carry out field investigations of the performance of preserved wood foundations, and

3. to analyze the data and recommend changes to existing preserved wood foundation standards and building codes, as appropriate.

### METHODOLOGY

The data gathering phase of the project was divided into 5 tasks. These included:

1) computer search of 7 construction and forestry databases,
2) a literature review of 79 publications and papers,
3) a key actor survey involving 14 industry repesentatives,
4) site inspection and material sampling at 32 test homes, and
5) a questionnaire sent to 225 owners (128 respondents).

The 32 site inspections involved a detailed review of the residences and discussions with the owners plus the collection of soil samples and 25 wood samples from each PWF.

The soil and wood samples were collected and analyzed for moisture content by the investigator according to applicable testing standards.

## KEY ISSUES & FINDINGS

The key issues raised in the study concerned the wood and soil moisture values as they were affected by prevailing construction practices and how they in turn affected the PWF basement. It was noted that the general construction quality was acceptable; however, there were major deficiencies in selection and placement of backfill materials and in surface water management. Despite these shortcomings, the average moisture level in the preserved wood walls was not only below the 30% level at which decay is initiated, but was also below 15%. The latter finding is significant because "wet service condition" design parameters must be used when wood's moisture content reaches 15%. Whereas these parameters are more restrictive than the conventional "dry-service condition" parameters, wet-service wood design adds to the cost of any PWF.

## CONCLUSION

This study concluded that PWF basements perform exceptionally well despite the poor regime of water management found in the cases investigated. This implies that some of the design criteria and requirements may be unduly high. The study also concluded that where climatological and soil conditions are similar to those found in the test area, it may be possible to eliminate the use of preservative treated studs in favour of conventional lumber.

## 1.0 INTRODUCTION

### Background

Preserved wood foundations (PWF's) have been built in Canada for almost 30 years but have only been built in Alberta since the mid-seventies after the Building Standards Branch of Alberta Labour authorized PWF construction through the issuance of a StanData. This foundation system was later incorporated into the 1980 Alberta Building Code by way of a new StanData. By 1985 the system was fully integrated into the Code as articles 9.15.1.6 and 9.15.1.7. The articles set CAN3-S406-M83. "Construction of Preserved Wood Foundations" as the design and construction standards for PWF's in Alberta.

### Problem Definition and Study Purpose

While there has been considerable use of PWF's, there has been no systematic attempt to date to investigate, analyze and evaluate their performance. The purpose of this research project was to evaluate the performance of preserved wood foundations built in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate. The detailed objectives of the study were:

1. to carry out a review of published information and to survey key actors in the preserved wood foundation industry,

2. to carry out field investigations of the performance of preserved wood foundations, and

3. to analyze the data and recommend changes to existing preserved wood foundation standards and building codes, as appropriate.

The project investigated a sample of foundations which were built during the last 15 years when most PWF's in Alberta were built.

### Study Approach

The researcher gathered information and data from a variety of sources. Contextual and historic data were obtained from an extensive review of data bases, monograms and publications dealing with PWF's. This information was augmented by a survey of 14 industry representatives. Investigation of existing PWF conditions at each of the 32 homes which were selected for study encompassed the following activities:

i) a visual inspection of the home and a survey of each owner's experiences and opinions (the survey procedure was augmented by the distribution of questionnaires to an additional 225 owners of PWF; 128 responded);

ii) the collection and laboratory analysis of a representative soil column at each site; and

iii) the laboratory analysis of 25 wood samples collected from each basement structure and foundation.

Based on an evaluation of the investigation findings, the researcher developed alternate construction scenarios and prepared comparative cost analysis.

Report Organization

The remainder of the report is divided into four parts:

Section 2.0 discusses the results of the literature review and survey of key industry actors.

Section 3.0 summarizes the research procedures in three sub-sections with respect to site visits and an owner questionnaire, soil sampling and analysis, and the sampling and and analysis of PWF wood samples. Each of these sub-sections discusses methodology, findings and conclusions.

Section 4.0 looks at the economic implications of alternative methods of construction and material options.

Section 5.0 contains conclusions.

The report also includes extensive technical Appendicies (A to G) which contain information on data sources, interview and questionnaire responses, results of wood and soil analysis, and testing and design standards for wood foundations.

## 2.0 LITERATURE REVIEW AND KEY ACTOR SURVEY

### Introduction

In order to establish the current state of development of PWF's, the investigator conducted an extensive literative review of books and articles, and a survey of 14 of 22 key industry representatives contacted.

Findings from both the review and the survey suggested that PWF's are a viable building system whose proper execution and maintenance can result in an acceptable foundation and a superior interior environment. A summary of findings and comments from these two sources is provided below.

### 2.1 LITERATURE REVIEW

#### 2.1.1 Methodology

Information was gathered on the basis of a search of seven construction, engineering and forestry databases. In addition, the author reviewed a total of 79 books, articles and monograms.

Findings have been grouped by subject matter. Individual books or papers are referenced where they are deemed significant. The reference code consists of a letter and number designating the relevant page in Appendix A followed by a number indicating the number of the reference on that page.

#### 2.1.2 Findings

The literature discusses preservatives and wood performance, construction procedures and materials, and moisture within the home or building envelope.

##### Preservatives and Wood Performance

A 1985 report by L. I. Gaby (A2-8) describes the research and findings which arose from the construction of a test PWF in Athens, Georgia. While the test conditions vary from those to be found in a typical Canadian installation, the test was noteworthy for its generally positive findings which occurred in a hostile fungus and termite environment.

In the experiment, only part of the plywood foundation wall was covered with poly. This and the uncovered section were then monitored for moisture content weekly over a five-year period. The researchers made the following observations:

i) moisture content was seasonally cyclical; driest in winter, wettest in mid-summer;
ii) footing plates averaged 24% moisture content over the test period;
iii) 99% of the moisture readings taken from the basement ply below grade were less than 19%;
iv) 100% of the poly covered ply below grade exhibited moisture readings of 15% or less;
v) the moisture content of studs behind poly covered plywood averaged 10.8% over a range of 10.6% to 11.8%;
vi) studs behind plain plywood averaged a 12.6% moisture content; and
vii) on average, poly dampproofing lowered the wall moisture content readings 5% to 10%.

Construction Procedures and Materials

A number of reports including one by Scanada (A19) discussed and evaluated the rock drainage layer under PWF's. The concensus was that this was a very effective drainage technique and noted that the system could be installed in wet site conditions.

A comparison of prevailing American and Canadian standards indicates that in general, Canadian PWF's are built to higher and more demanding standards than those in the U.S.A. For example, in Canada stainless steel fasteners are required below grade, but these are not required in the United States. Where the U.S. permits the use of Grade I and occasionally Grade II soils in a 4" drainage pad, Canadian standards require a 5" pad of crushed rock. Finally, Canadian standards require more restrictive stress modification factors and base their design formulas on wet service conditions versus the American assumption of dry service conditions.

Moisture

The primary focus of PWF's will continue to be the exclusion of ground water from the basement. Those readers who wish to pursue this topic in greater detail might wish to read a book by R. A. Spray and F. A. Hedden (A3-25) entitled Field Observations of Moisture and Organism Damage in Insulated Houses. This thorough review of the issues covers both internal and external moisture sources, proper water management techniques, damage prevention and contains a section which describes warning indicators of impending moisture problems.

### 2.1.3 Summary

The literature was uniformly supportive of the PWF construction approach. The references noted that preservatives were effective in protecting wood from decay in even the most severe fungal and termite infested environments. Further, properly constructed wood basements were dry, warm and provided an excellent environment.

It was also noted that Canadian construction and material standards were higher than their American counterparts. While one must be careful about attempting a direct extrapolation of U.S. findings to Canadian situations, there is evidence to suggest that in some locations, it may be acceptable to use untreated lumber in wood foundations and to base design calculations on "dry service conditions".

## 2.2 Key Player Survey

Twenty-two industry representatives were invited to submit their views on specific issues with respect to PWF's. Fourteen of those contacted responded and, while there was considerable variation among those responses, there were also some common themes which merit discussion.

### Preservatives

Two respondents raised points related to the use of wood preservatives. One suggested that the level of treatment be reviewed to determine whether lower levels of chemical penetration could be allowed as this would significantly lower the material cost of a PWF. Another was concerned about the toxicity of the chemicals used and suggested that those handling preserved wood should be advised to wear a mask and gloves.

### Structure

Some respondents were concerned that the prevailing standard CAN3-S406-M83 should be more extensive and clear with respect to PWF structural requirements. Specifically, they wished to see information included on window framing and lintel design. It was noted that there had been PWF's failures in racking due to the differential pressures which result from uneven backfilling; consequently, it was suggested that the standard be expanded to include this topic. On the other hand, some concern was expressed that the existing standard was overly conservative. Particular reference was made to deletion of sleeper wood floors as a permitted design out of concern that some might fail. It was felt that the response should not have been deletion, but the development of a viable design and construction approach.

Finally, there was a call for the standard to recognize and adopt an approach to structural design which takes into account the contribution of all of the components of the system. In the existing standard the studs are designed to carry the full axial and laterial loads while the plywood is assumed to transfer only lateral loads to the studs. Composite design criteria would recognize the actual structural benefits which result from the composite/unified action of the plywood and studs working in concert to resist both axial and lateral loads.

Construction Practices

There were some minor remarks about ground water management. One questioned the correctness and effectiveness of current dampproofing methods. Another noted that he is successfully using weeping tiles as a drainage mechanism in PWF's.

The most critical concern addressed the improper application of the standard. In particular, contractors and designers often approve the use of improper backfill materials or procedures. Another respondent suggested that the current CSA standard CAN3-S406-M83 was being used as a construction handbook without proper consideration being given to how the specifications, conditions or underlying theory contained in that standard might apply to unique designs or site-specific problems.

## 3.0 RESEARCH PROCEDURES

The work encompassed site inspections, which included interviews with the owners; the collection and analysis of a typical soil sample of each home; and the collection and analysis of a variety of wood samples from various locations within each PWF basement that was studied.

The site investigations were based on a sample size which would provide a high level of confidence that findings would be representative of the universe of PWF's with respect to the key attribute, moisture content of the studs in PWF exterior walls. The total sample population was 2500 units. The chosen level of confidence was 99% and the acceptable deviation from the mean was set at 2%. It was assumed that the mean moisture content would be 15% and the range of samples would be 10% to 35%. These assumptions were in fact validated during the testing phase. Based on the above considerations, the required sample size was calculated to be 32 PWF's.

The research activities are discussed in the following sections. Each section in turn discusses the procedure, findings, and conclusions and recommendations related to that activity.

### 3.1 Site Inspection and Owner Interviews

The 32 owners who participated in the study were chosen from the files of the investigator's firm, Brown Engineering. The site visits and interviews were augmented by approximately 225 additional questionnaires which were sent to other owners of PWF's which had been also designed by Brown Engineering.

The 32 site reviews resulted in a diverse range of observations. However, there were a number of commonalities which merit discussion.

Nearly two thirds of the homeowners installed and maintained proper eavestroughs and downsponts as a means of surface water management, but nearly 60% of the lots were improperly graded and had sites which sloped toward the home. While it was impossible to inspect the exterior dampproofing because of landscaping, it was noted that despite the generally poor grading only three of the homes had experienced any form of basement leakage. In fact, the sump pumps in seven of the homes had never been active. This appears to suggest that with proper, well graded backfill and appropriate water management little or no water will reach the drainage layer and sump pump.

An inspection of the studdings showed them to be performing within design limits. The only exception was in a wall where the deflection was 70mm or 5/180. The studs involved did not bear any markings or grade stamp. The wall appears to have been constructed with American stud grade material. This lumber entered the Canadian market in the late seventies when domestic supplies could not meet the boom demand.

In walls where the displacement was within design norms, deflections of up to 1/180 were not considered aesthetically unpleasing. This observation was due to two factors. Firstly the maximum deflection is generally within 450mm of the floor and out of the main line of sight. More importantly, the deflection occurs during backfilling before the application of finishes and consequently, the drywall is applied and taped in a bowed configuration which results in a smooth finish with no cracks.

No galvanized framing anchors or straps showed any sign of deterioration, thus indicating that they were performing well. However, it was also noted that there had been a lapse in construction quality in some of the homes. Six of 32 homes did not have any insulation in the joist box spaces at the main floor. More importantly, 24 of 32 homes or 75% did not have an effective air/vapour barrier on the basement PWF walls.

Despite these various shortcomings, the 32 PWF's inspected were rated as being very good or excellent and were uniformly lauded by their owners. Most of the faults, such as poor eavestrough, could be readily corrected. Problems such as the poor grading and no air/vapour barrier might have been eliminated entirely with more stringent enforcement of the building code by local building inspectors.

The high positive evaluation from the site investigations and interviews was echoed in the broader survey of owners via the mailed questionnaire. A total of 128 out of 225 were returned for a response rate of 57% which is considered excellent for this type of survey. The survey is summarized in Appendix C for those who wish to undertake a detailed analysis. Readers interested in measures of satisfaction are directed to questions 8, 11, 13, 28, 33, 70 and 73. PWF performance is rated in questions 12, 33, 60 - 62 and 70 - 73. Care of construction was covered in questions 10 and 67b; questions 68 and 69 address insurance and resale value.

In summary, one could make the following generalities:

i) occupants of properly constructed PWF's are satisfied with their homes;
ii) properly constructed PWF's perform very well and provide dry, warm and comfortable living space;
iii) PWF's are perceived as easy to build;
iv) PWF's don't result in any insurance surcharge, and
v) owners of PWF's consider them equal to or better than other types of basement construction with which they have experience.

## 3.2 SOIL SAMPLES

### 3.2.1 Sampling Procedures

Soil samples were obtained at each of the 32 inspected homes. The samples were taken at a distance of 900mm from the basement wall and obtained using a 50mm hand auger. The test holes were driven below the footing plate and drainage layer in order to obtain a representative sample of the underlying soil. Upon removal, samples were vacuum sealed in poly bags and marked for identification before being returned to the laboratory for testing.

Moisture content of the soil samples was determined in accordance with standard ASTM D 2216-80 "Standard Method for Laboratory Determination of Water (Moisture) Content of Soils, Rock and Soil Aggregate Mixtures". The resulting findings were plotted on the moisture -vs- location graphs located in Appendix E. In addition to moisture content, each plot was identified for its typical drainage pattern; negative, positive or neutral.

The soil samples were analyzed for type and classified in conformance with the "Unified Soils Classification System". This information is also noted on Appendix E plots.

### 3.2.2 Findings

There were two significant observations. As noted on plot E9, when topsoil and organics are mixed with the granular backfill, there is a significant increase in normal moisture content, in this instance, from 8% to 22%. In instances where the native soil/sands exhibit high permeability, such as E9 and E17, the resulting moisture levels are very low being 5% and 8% at 360mm and 900mm below the footings respectively.

It was also noted that only in the case of basement E9 was the backfill installed as specified, that is, free draining granular backfill below 450mm of an impermeable topsoil cap.

Yet, despite this rather significant shortcoming in construction, the soils appeared to exhibit generally acceptable moisture profiles. It was calculated that some walls were carrying backfill pressures up to three times as high as the limits specified in CAN3-S406-M83.

### 3.2.3 Conclusion & Recommendations

In light of the findings, it is suggested that where the native soil exhibits a sufficiently high permeability, it is not necessary to install a 6" granular drainage layer below the PWF construction. Further, it is noted that most basements have exhibited adequate ground moisture control without the mandated drainage layer; consequently, it is recommended that a combined backfill of stiff to medium clay over a granular material would be acceptable. There are however two caveats; (i) the combined backfill must not result in forces which exceed allowable stress and deflection limits in the studs and plywood and (ii) the equivalent fluid pressures used for the clay in the design calculations must equal 75pcf, which places limitations on the type of clay that can be used.

Finally, it is noted that only 3% of the basements had been backfilled or graded in conformance with prevailing code requirements; consequently, it is recommended that the building code be clarified to emphasize that the authority having jurisdiction is responsible for the inspection and approval of these construction practices.

## 3.3 WOOD SAMPLES

### 3.3.1 Sampling Procedures

Approximately 25 wood samples were taken from different locations in the foundations of each of the inspected homes as noted on Figure 3.3.1, page 14. These were subsequently tested in the laboratory to ascertain their moisture content.

One sample was taken from each of the following locations:

i) PWF bottom plate (It was not possible to secure samples from the footing plates),
ii) top plate,
iii) tie plate,
iv) bottom plate of an interior partition, and
v) 75mm above bottom plate in interior partition.

Two samples were taken from a main floor joist. Samples of the outer, middle and inner thirds of the studding were taken from each of the following six locations in the selected PWF stud at each house:

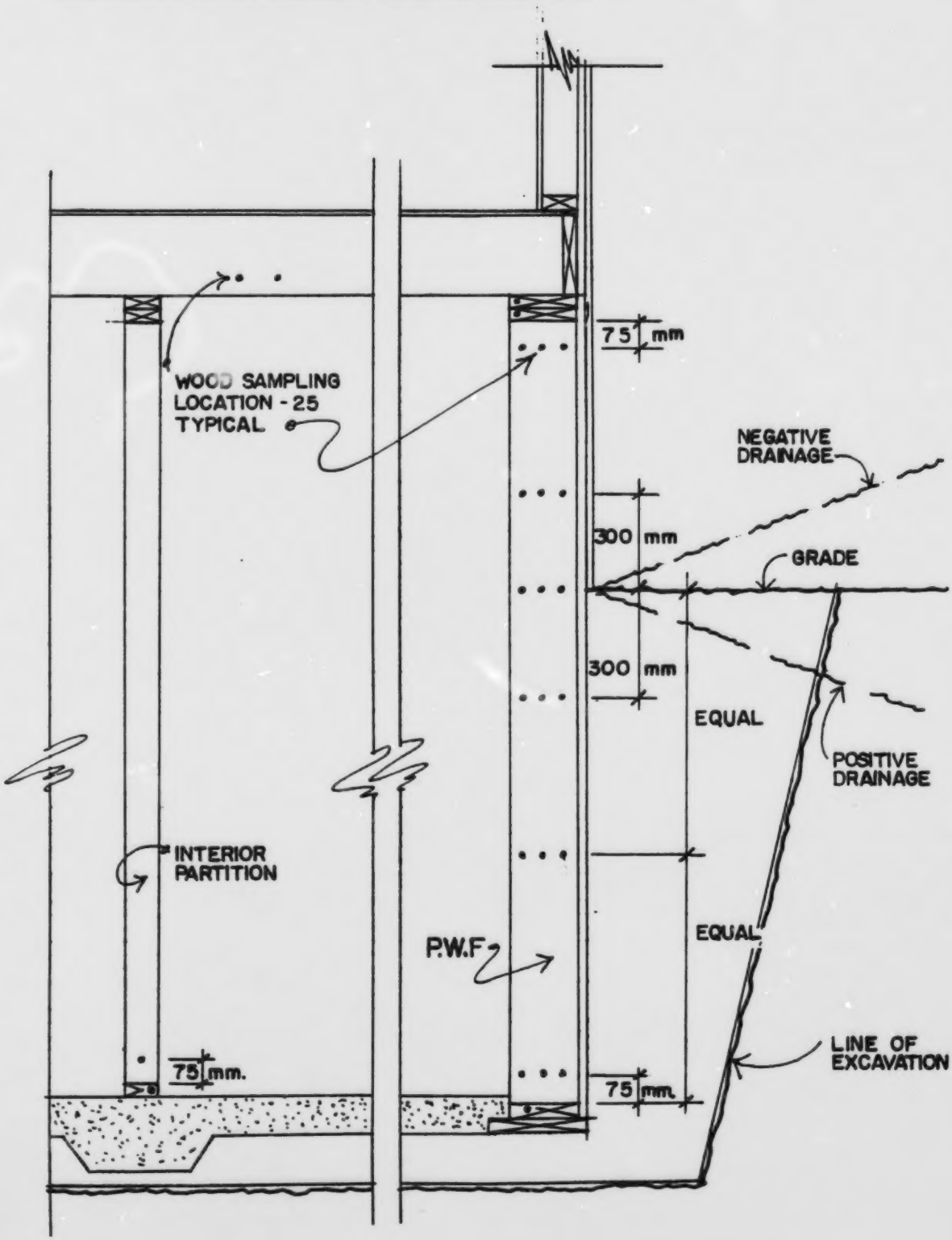
i) 75mm below the top plate,
ii) 300mm above grade,
iii) level with grade,
iv) 300mm below grade,
v) at mid-point of backfill, and
vi) 75mm above the bottom plate.

Samples were not obtained from the exterior plywood sheathing of the basements as all sampled homeowners were unwilling to have any punctures made in their primary moisture barrier. However electronic moisture meter readings were made of the PWF plywood at each location where wood samples were taken.

The samples, taken during the last week of July and August 1987, were collected in accordance with the recognized standard ASTM D 2016-74 (Reapproved 1984) "Standard Test Methods for Moisture Content of Wood". Wood samples were obtained using a powered 1/2" plug cutter. After extraction, the cores were placed in a poly bag, vacuum sealed, and identified before transportation to the laboratory for testing.

# FIGURE 3.3.1

## WOOD SAMPLING LOCATIONS



The moisture content of the samples were also determined in accordance with standard ASTM D 2016-74. The procedure involved the precise weighing of the wood samples before and after heating in an oven. The weight differential is assumed to be due to the loss of moisture and is expressed as a percentage of the wood's dry weight. All of the moisture content readings were used in the data analysis.

### 3.3.2 Findings

The moisture readings were plotted on a variety of moisture-vs-location graphs. These graphs are to be found in Appendix D, pages D1 to D58. The graphs on pages D2 and D3 illustrates the moisture profiles across the face of the studs for the positive, negative and combined drainage. Page D7 provides an analysis of the vertifical moisture profiles in the studs. Pages D10 to D58 inclusive present detailed plots and distribution curves of the moisture content readings for the full range of wood samples.

The analysis of the samples produced the following key findings:

i) Moisture contents were always highest when the site sloped towards the house i.e. negative drainage.
ii) The studs had higher moisture content towards their outside face.
iii) No stud exhibited a moisture content above 30% which is generally accepted as the point at which rot can occur.
iv) Base plates exhibited moisture levels above 30%.
v) Moisture content of studs decreases with distance above the base plate.
vi) Even under adverse negative drainage conditions, the mean, stud moisture contents did not exceed 15% at any points other than the point 3" above the base plate.

### 3.3.3 Conclusions and Recommendations

A test of the assumptions noted in Section 3.0 on methodology indicates that the study findings are accurate to 2% at a 99% level of confidence. Based on the findings one can make the follow recommendations.

1) Because no moisture contents exceeded 30% or even 15% above 3" over the plate, PWF studs in climatic and soil conditions similar to the test area need not be treated with preservative.

2) Dry service conditions can be used in calculating structural performance as studs only exhibit high (15%+) readings in the lower 3".

3) The inclusion of a dampproofing material between the base plate and the studs would eliminate the wicking effect from the moist plate into the essentially dry stud.

## 4.0 ECONOMIC ANALYSIS

The study included an economic analysis of the impact which proposed changes might have on the cost of a PWF for the typical single family home. The analysis was based on a hypothetical foundation which was 32' X 40' and had an 8' high wall. It was assumed that the excavation extended 2' beyond the base of the wall and sloped outwards to 3' beyond the wall at the top of the excavation. The analysis was based on Edmonton retail prices as of September 1987. The analysis encompassed four areas of interest: untreated lumber, dry service design conditions, backfill options and material substitutions.

### Savings with Untreated Lumber

The field investigation and laboratory tests suggested that it was possible to build parts of PWF's with untreated lumber in certain situations (Section 3.3.3). When compared to the cost of treated dimensional stock found in the average PWF, it was found that use of untreated 2 X 6 @ 16" o.c. #2 SPF would save an average of $269.00 in our hypothetical example. When the sheathing is installed horizontally, the saving on untreated blocking material adds another $30.00 to that amount.

### Savings from Designing for "Dry Service" Condition

As previously noted, the low moisture content not only inhibits decay, but also allows the designer to base his structural design on "dry service" wood performance. When allowances are made for this improved performance, it was found that when dealing with the average backfill height of 6'-1", one can use 2 X 6 @ 16" on centre rather than 2 X 6 @ 12" on centre. This reduction in lumber permits a saving of $230 on the foundation.

### Savings from Using Existing Soils (rather than replacing them with sand)

Because of the very wide variety of soil conditions and backfill heights, it was necessary to develop a variety of scenarios for consideration. Based on the field work and soil analysis, it was considered appropriate to analyze three combinations of backfill. In the analysis, an allowance was provided for savings from the non-disposal of excess clay, and the sand backfill was considered as having a 1' clay cap. It was assumed that the clay came from the PWF excavation.

Case #I - Backfill Height 4'-6"

In this typical bi-level arrangement, the 2 X 6 stud spacing decreases from 16" o/c to 12" o/c and the corresponding figures are plus $140 for lumber minus $607 on material for a net saving of $467.

Case #II - Backfill Height 5'-0"

With a sand backfill, one requires a 2 x 6 @ 16" #2 SPF stud wall. With 5' of clay, the wall must be upgraded to 2 x 8 @ 16" #2 SPF. While this increases the lumber costs by $177, one saves $703 on backfill and haulage costs for a net gain of $526.

Case #III - Backfill Height 6'-0"

Using the logic outlined in Case I, lumber increases from 2 X 6 @ 16" to 2 X 8 @ 12". Wood costs rise by $887 for a net saving of $511.

Savings from Material Substitution

Finally, the study considered the economic implications of making substitutions in some of the conventional materials used in PWF's. The two areas which lent themselves to the greatest potential benefit were the footing and drainage layer.

Traditionally market forces have shown that while owners will accept a wood foundation, they have insisted on retaining a concrete footing. The analysis showed that the difference in cost between a 2 X 8 PWF footing, $104, and an 8 X 18 concrete footing, $404, is $300.

As shown in the soil analysis and documented in the sample profiles, it is possible to eliminate the rock or gravel drainage layer where the undisturbed native soils exhibit sufficient porosity. It was calculated that the 6" drainage layer costs upwards of $414.

Cumulative Savings

It would appear that careful material selection and the use of site specific design standards can result in significant savings. A summary of these savings is provided below:

| | | |
|---|---|---|
| i) | Untreated Lumber | $ 269.00 |
| | - Untreated Blocking | 30.00 |
| ii) | Dry Service Conditions | 230.00 |
| iii) | Existing Soil Backfill (average) | 500.00 |
| iv) | Material Substitution | 300.00 |
| | Average Anticipated Savings | $ 1,329.00 |
| v) | Delete drainage layer | 414.00 |
| | Optimum Savings | $ 1,743.00 |

In light of the significant potential savings which can result from careful design and material selection, these options merit serious consideration.

## 5.0 CONCLUSION

The foregoing economic appraisal and an analysis of the research findings, suggest a reconsideration and re-evaluation of PWF standards.

The findings generally indicate extremely low moisture content in the studs despite the poor water and drainage management actions taken at the homes that were investigated. These findings suggest that designers take a more site-specific approach to their design and calculation of PWF's to achieve a more rational and cost-effective design. Furthermore, there is considerable evidence in the economic analysis to suggest that the potential savings will not only pay for the additional design services but will also return a significant financial benefit to the owner.

While these findings and recommendations are currently limited in application to those areas with soil and climatic conditions similar to the Edmonton area, the conclusions reached in this report should be seriously considered for their potential impact on all PWF installations.

# Appendix A - Literature Review and Key Actor Survey

## Part 1 - Bibliography

The published and non-published information that was obtained and reviewed is listed on pages A2 to A9.

## BIBLIOGRAPHY

Published and Non-Published Information Obtained and Reviewed

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## GROUP II Innovative Design Publications


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House.

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1974. An All-Weather Wood Foundation for a Basement House.

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1. ASTM D 1037 - 78 Standard methods of Evaluating the Properties of Wood Base Fibre and Particle Panel Materials.

2. ASTM D 2216 - 80 Standard method for Laboratory Determination of Water (Moisture) Content of the Soil, Rock and Soil-Aggregate Mixtures.

3. ASTM D 3017 - 78 Standard test method for Moisture Content of Soil and Soil Aggregate in Place by Nuclear Methods (Shallow Depth).

4. ASTM D 1860 - 63 (Reapproved 1981) Standard test method for Moisture and Creosote Type Preservative in Wood.

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## Appendix A Literature Review and Key Actor Survey.

### Part II Databases Searched

This Part II contains the list of databases that were searched by the Alberta Research Council and the National Research Council.

Appendix A Databases Searched for Literature Review.

1. FOREST (Forest Products).
2. BRIX (Building and Construction).
3. PICA (Construction and Architecture).
4. EI (Engineering Information).
5. EIM (Engineering Information - Meetings).
6. NTIS (U.S. National Technical Information Services - Government Reports).
7. OON (National Research Council, Canada-in house Publications).

Appendix A Literature Review and Key Actor Survey.

Part III Samples Documents for Key Actor Survey

This Part III contains a sample of the documents sent to persons contacted during the key Actor Survey.

Brown Engineering
Consulting Engineers

#234, 9738 - 51 Avenue
Edmonton, Alberta
T6E 0A6

Telephone (404) 437-4702

September 17, 1987

Hello

My name is Terry Brown and I am the principal of Brown Engineering an Edmonton based Consulting Engineering firm. We have specialized in the design of Preserved Wood Foundations over the past 12 years and to date we have designed PWF's for over 3000 residential housing units and a number of commercial projects.

We are presently commencing a very detailed research project into the performance of PFW's that have been installed over the past 15 years. Attached is a photo copy of part of the Terms of Reference for this study. By way of this letter we are requesting any additions to the scope of the project that you may feel would be beneficial in assessing the total performance of the PWF system.

We are also requesting that if you have any questions regarding the contents of CAN 3 S 406 M 83 Construction of Preserved Wood Foundations that you also forward these to us.

If you should have any technical reports on the performance of PFW's we would appreciate a copy of them or the source where we may obtain a copy.

We are working on a tight schedule and therefore request that you forward any input to us within 14 days of receiving this letter, a self addressed envelope for this purpose is enclosed or if you so desire you may phone me collect at (403) 437-4702.

Thank you for your co-operation.

Yours truly,

Terry N. Brown, P.Eng.

## SCHEDULE A

## TERMS OF REFERENCE

## PRESERVED WOOD FOUNDATION STUDY

### A. INTRODUCTION

Although preserved wood basements have been in use for almost thirty years, it was not until the late seventies that they started to be built in considerable numbers in Alberta. The current standard for preserved wood foundations (PWF), CAN 3-S406-M83 (enacted in 1984) was the first of its kind and is based on very conservative engineering practice. Furthermore, there is little empirical information available on their performance. This project, which is jointly funded by the Alberta Departments of Municipal Affairs - Housing and Forestry, Lands and Wildlife responds to the need to assess the performance and to suggest more cost-effective standards.

### B. OBJECTIVES

The purpose of this research project is to carry out extensive field investigations on the performance of preserved wood foundations built over the last 15 years in Alberta and to recommend changes to the current standard for preserved wood foundations, if appropriate.

The detailed objectives of this research project are as follows:

1. To carry out a review of published information and to survey key actors in the preserved wood foundation industry to identify key issues.

2. To carry out field investigations to determine the performance of preserved wood foundations.

3. To analyze the data and recommend changes to existing preserved wood foundation standards and building codes.

4. To prepare a final report summarizing this research project.

5. Present the findings of the study to appropriate standard writing committees if authorized by both funding Departments.

C. SCOPE

The scope of this research project is as follows:

1. To carry out a review of published information on preserved wood foundations, basement waterproofing and basement drainage systems.

2. To survey key actors in the preserved wood foundation industry to determine if any additional research should be carried out during the field investigations of existing preserved wood foundations.

3. To carry out field investigation on existing preserved wood basements to determine the following:

   i) the moisture content of preserved wood foundations with treated as well as untreated studs and back-fill;
   ii) deterioration of treated and untreated wall studs, plates and sheathing;
   iii) the deflection of wall studs;
   iv) the conditions of various types of fasteners applied to the preserved wood foundations; and
   v) the qualitative performance of the basement wall waterproofing and drainage system.

4. To analyze the data generated by the field investigations and laboratory tests and compare them with findings of the literature review and recommend changes to CAN 3-S406-M83, Alberta Building Code and other related standards and codes.

5. To prepare interim reports and a final report summarizing the work in accordance with Schedule 'B'.

6. To disseminate, in accordance with article 10 of the Letter of Agreement, the findings of the study to the recently re-established CSA committee on preserved wood foundations, the Associate Committee on the National Building Code, and other appropriate standard writing committees and organizations.

D. FOCUS

The study shall focus on the field investigation of the performance of preserved wood foundations built between 1970 and 1985 and the analysis of the field data leading to recommendations for changes of existing preserved wood standards and codes.

E. APPROACH

The work shall be divided into the following phases and include the tasks set out below.

## Appendix A Literature Review and Key Actor Survey

### Part IV Key Actors Surveyed

This Part IV contains the names of the persons and firms that were contacted during the Key Actor Survey portion of this study.

## PERSONAL CONTACTS

| Name | Response | Type of response<br>1. Telephone<br>2. Written<br>3. Meeting |
|---|---|---|
| 1. Mr. T. Bearden, P.Eng.<br><br>Bearden Engineering Consultants Ltd.<br>250 4919 - 59 Street<br>Red Deer, Alberta<br>Canada T4N 2N1 | | Yes 1 |
| 2. Mr. G.E. Brudermann<br><br>Domtar Chemicals Group<br>Wood Preserving Division<br>104 Doyon Avenue<br>Pointe Claire, Quebec<br><br>Phone: (514) 694-2162 | | No |
| 3. Mr. Colin Campbell, P.Eng.<br><br>Campbell, Woodall & Associates Ltd.<br>250 1210 - 8 Street S.W.<br>Calgary, Alberta<br>Canada T2R 1L3<br><br>Phone: 228-3178 | | Yes 2 |
| 4. Mr. B. Davison, P.Eng.<br><br>B. Davison Consulting Engineer Ltd.<br>8107 - 143 Street<br>Edmonton, Alberta<br>Canada T5R 0N9 | | Yes 1 |
| 5. Mr. Fred Dumont<br><br>National Research Council<br>110 Gymnasium Road<br>Saskatoon, Sask.<br>Canada S7K 5T6 | | Yes 1 |

## PERSONAL CONTACTS

| Name | Response | Type of response<br>1. Telephone<br>2. Written<br>3. Meeting |
|---|---|---|
| 6. Mr. Bruce Fulford<br><br>Koppers-Hickson Canada Ltd<br>2233 Argentina road<br>Suite 303<br>Mississuaga, Ontario<br>Canada M5N 2X7<br><br>Phone: 1-800-387-8349 | | Yes 2 |
| 7. Mr. Gary Gibson, P.Eng.<br>Sure West Consulting Services<br>P.O. Box 5019<br>Ded Deer, Alberta<br>Canada T4N 6A1 | | No |
| 8. Mr. Bill Glover<br><br>Canadian Standards Association<br>178 Rexdale Blvd.<br>Rexdale, Ontario<br>Canada M9W 1R3 | | Yes 3 |
| 9. Mr. K. Hanson<br><br>Victory Homes<br>#110 - 2103 Airport Drive<br>Saskatoon, Sask.<br>Canada S7L 6W2 | | No |
| 10. Mr. M.S. Hollick, President/Manager<br><br>Exterior Wood Limited<br>9697 - 190 Street<br>Surrey, British Columbia<br>V3T 4W2 | | Yes 1 |
| 11. Mr. Eric Jones<br><br>Canadian Wood Council<br>85 Albert Street<br>Ottawa, Ontario<br>Canada K2P 0M8 | | Yes 1 |

## PERSONAL CONTACTS

| Name | Response | Type of response<br>1. Telephone<br>2. Written<br>3. Meeting |
|---|---|---|
| 12. Mr. L.J. Lappi, P.Eng.<br><br>Canada Mortgage and Housing<br>Suite 300 410 - 22 Street East<br>Saskatoon, Sask.<br>Canada S7K 5T6 | Yes | 2 |
| 13. Mr. R.N. Massiah, P.Eng.<br><br>Alberta Dept. of Labour<br>707, 10808 - 99 Avenue<br>Edmonton, Alberta<br>Canada T5K 0G5 | Yes | 2 |
| 14. Mr. Dave Milton<br><br>Canadian Institute of Treated Wood<br>#506 75 Albert Street<br>Ottawa, Ontario<br>Canada K1P 5E7 | Yes | 1 |
| 15. Mr. W.M. McCance, P.Eng.<br>The Waterboard Association<br>75 The Donway W. Suite 400<br>Don Mills, Ontario<br>Canada M3C 2E9<br><br>Phone: (604) 278-0963 | No | |
| 16. Mr. Tom McGill and<br>Mr. Tom Morayto<br><br>Timber Specialties<br>6521 Mississuaga Road<br>Mississuaga, Ontario<br>Canada L5N 1A6 | No | |
| 17. Mr. R.H.B. McLaughlin, P.Eng.<br><br>University of New Brunswick<br>P.O. Box 4400<br>Fredericton, New Brunswick<br>Canada B3H E3B | No | |

## PERSONAL CONTACTS

| Name | Response | Type of response<br>1. Telephone<br>2. Written<br>3. Meeting |
|---|---|---|
| 18. Mr. H.A. Nagac, P.Eng.<br><br>Ace Engineering Ltd.<br>1380 Commercial Way<br>Penticton, British Columbia<br>Canada V2A 3H6<br><br>Phone: (604) 493-7211 | | No |
| 19. Mr. P.E. Rivers, P.Eng.<br><br>Rivers P E Associates Ltd.<br>106 10510 - 121 Street<br>Edmonton, Alberta<br>Canada T5N 1L4 | | Yes 1 |
| 20. Mr. M. Rossiker, P.Eng.<br><br>Mid Canada Consulting Group Ltd.<br>17 Rowland Crescent<br>St. Albert, Alberta<br>Canada T8N 3X4<br><br>Phone: 458-0078 | | Yes 1 |
| 21. Mr. D.L. Scott<br><br>National Research Council of Canada<br>Atlantic Regional Station<br>Div. of Building Research<br>1411 Oxford Street<br>Halifax, Nova Scotia<br>Canada B3H 3Z1<br><br>Phone: (902) 428-8255 | | No |
| 22. Mr. Jerry Van-Rajn<br><br>Forentec Canada Corporation<br>800 Montreal Road<br>Ottawa, Ontario<br>Canada K1G 3Z5 | | Yes 2 |

## Appendix B Inspection and Sampling.

The results of the inspections and a table showing the year of construction are contained in this Appendix.

## Appendix B Inspection and Sampling.

### Part I A Summary of the Inspection Results.

The summary of the inspection results is contained in pages B2 to B8. Additional inspection information is summarized on pages B10 and B11.

## INSPECTIONS

1.0 EXTERIOR DRAINAGE OF GROUP

| | | |
|---|---|---|
| .1 | Positive. | 14 |
| .2 | Negative with Sod. | 12 |
| .3 | Negative without Sod. | 7 |

Total Number of samples = 33

2.0 EAVESTROUGH

| | | |
|---|---|---|
| .1 | Eavestrough with downspouts draining water away from the building. | 20 |
| .2 | Eavestrough with no drainage away from the building. | 9 |
| .3 | No Eavestrough. | 4 |

Total Number of samples = 33

3.0 INTERIOR LEAKAGE AND FLOODING

| | | |
|---|---|---|
| .1 | Water leaking into foundation through exterior wall. | 3 |
| .2 | Water leaking into foundation through the floor. | 1 |
| .3 | No leakage. | 28 |

Total Number of samples = 32

4.0 TYPE OF FOOTING

| | | |
|---|---|---|
| .1 | Wood | 19 |
| .2 | Concrete on soil | 5 |
| .3 | Concrete on gravel | 1 |
| .4 | Concrete on soil with drain pipes | 2 |
| .5 | Unable to Identify | 5 |

Total Number of samples = 32

5.0 BASEMENT FLOOR

.10 TYPE

| | | |
|---|---|---|
| .1 | Concrete | 19 |
| .2 | Suspended | 4 |
| .3 | Wood Sleeper | 9 |

Total Number of samples = 32

.20 DIFFERENTIAL ELEVATION OF FLOOR

| | | |
|---|---|---|
| .1 | Very little | 2 |
| .2 | 1/2" - 1" | 2 |
| .3 | To small to measure | 28 |

Total Number of samples = 32

.30 CONCRETE FLOOR CRACKING

| | | |
|---|---|---|
| .1 | No cracking | 9 |
| .2 | Small cracks | 8 |
| .3 | 1/8" - 1/4" cracks | 1 |
| .4 | 1/4" plus cracks | 0 |
| .5 | Unable to determine | 1 |

Total Number of samples = 19

6.0 TYPE OF WALL

.10 PLYWOOD

| | | |
|---|---|---|
| .1 | 1/2" perpendicular | 18 |
| .2 | 1/2" parallel | 4 |
| .3 | 5/8" perpendicular | 3 |
| .4 | 5/8" parallel | 0 |
| .5 | Unable to Identify | 7 |

Total Number of samples = 32

.20 STUD SIZE AND SPACING

| | | |
|---|---|---|
| .1 | 2x6 | 27 |
| .2 | 2x8 | 8 |
| .3 | 2x10 | 0 |
| .4 | 12" on centre | 4 |
| .5 | 16" on centre | 31 |
| .6 | Other | 0 |

Total Number of samples = 35

.30 STUD GRADE

| | | |
|---|---|---|
| .1 | Select structural | 0 |
| .2 | No. 1 | 8 |
| .3 | No. 2 | 19 |
| .4 | Unable to identify | 9 |

Total Number of samples = 36

.40 STUD SPECIES

| | | |
|---|---|---|
| .1 | D. FIR | 0 |
| .2 | H. FIR | 7 |
| .3 | S-P-F | 5 |
| .4 | L. PINE | 9 |
| .5 | J. PINE | 5 |
| .6 | Unable to identify | 9 |

Total Number of samples = 35

.50 DEFLECTIONS IN THE STUDS

| | | |
|---|---|---|
| .1 | 0 | 16 |
| .2 | 0 - 1/4" | 10 |
| .3 | 1/4" - 1/2" | 7 |

.4 Other See page B10 for breakdown of other deflections.

Total Number of samples = 35

.60 CHEMICAL TREATMENT

| | | |
|---|---|---|
| .1 | CCA | 32 |
| .2 | ACA | 0 |
| .3 | Unable to determine | 0 |

Total Number of samples = 32

.70 DAMPROOFING

| | | |
|---|---|---|
| .1 | 6 Mil Poly | 6 |
| .2 | Bituminous Dampproofing | 11 |
| .3 | 6 Mil Poly and Bituminous Dampproofing | 3 |
| .4 | Unable to determine | 12 |

Total Number of samples = 32

.80 INTERIOR CONDENSATION

| | | |
|---|---|---|
| .1 | No Condensation | 32 |
| .2 | Condensation | 0 |

Total Number of samples = 32

.90 WALL HEIGHT

| | | |
|---|---|---|
| .1 | 0 ft - 4 ft | 0 |
| .2 | 4 ft - 7 ft | 0 |
| .3 | 7 ft - 8 ft | 34 |
| .4 | 8 ft - 9 ft | 0 |
| .5 | 9 ft - 10 ft | 1 |

Total Number of samples = 35

7.0 BACKFILL HEIGHT

| | | |
|---|---|---|
| .1 | 0 - 4 ft | 1 |
| .2 | 4 ft - 5 ft | 6 |
| .3 | 5 ft - 6 ft | 19 |
| .4 | 6 ft - 7 ft | 4 |
| .5 | 7 ft - 8 ft | 2 |

Total Number of samples = 32

8.0 FRAMING STRAPS INSTALLED

| | | |
|---|---|---|
| .1 | Yes | 29 |
| .2 | No | 2 |
| .3 | Unable to determine | 1 |

Total Number of samples = 32

9.0 FRAMING ANCHORS INSTALLED

| | | |
|---|---|---|
| .1 | Yes | 24 |
| .2 | No | 1 |
| .3 | Unable to determine | 7 |

Total Number of samples = 32

10.0 MAIN FLOOR FRAMING

.10 BEAMS

| | | |
|---|---|---|
| .1 | 3 Ply 2x10 | 9 |
| .2 | 4 Ply 2x10 | 8 |
| .3 | 3 Ply 2x12 | 1 |
| .4 | 4 Ply 2x12 | 1 |
| .5 | glu-lam | 1 |
| .6 | None | 6 |
| .7 | Other See page B10 for break down of other. | |

Total Number of samples = 26

.20 FLOOR

| | | |
|---|---|---|
| .1 | 2x10 @ 16" O.C | 22 |
| .2 | 2x10 @ 12" O.C | 1 |
| .3 | 2x12 @ 16" O.C | 0 |
| .4 | 2x12 @ 12" O.C | 0 |
| .5 | TJI | 0 |
| .6 | Floor Trusses | 6 |
| .7 | Other See page B10 for breakdown of other. | |

Total Number of samples = 27

11.0 INTERIOR BRG WALLS

| | | |
|---|---|---|
| .1 | 2x4 @ 12" O.C | 0 |
| .2 | 2x4 @ 16" O.C | 0 |
| .3 | 2x6 @ 12" O.C | 0 |
| .4 | 2x6 @ 16" O.C | 20 |
| .5 | None | 12 |

Total Number of samples = 32

12.0 JOIST BOX SPACE TREATMENT

.10 INSULATION

| | | |
|---|---|---|
| .1 | Fiberglass insulation | 25 |
| .2 | Styrofoam | 1 |
| .3 | Nothing | 6 |

Total Number of samples = 32

.20 AIR/VAPOUR BARRIER PERFORMANCE

| | | |
|---|---|---|
| .1 | Excellent | 7 |
| .2 | Good | 1 |

.3 Fair [6]

.4 Poor [1]

.5 Nothing [17]

Total Number of samples = [32]

13.0 SUMP

.10 TYPE

.1 Plywood sump box [20]

.2 FIO Drain [2]

.3 Other See page B10 and B11 for breakdown of other.

.4 None [5]

Total Number of samples = [32]

.20 SUMP ACTIVITY

.1 Continually active [6]

.2 Seasonably active [8]

.3 Never active [7]

.4 Unable to determine [11]

Total Number of samples = [32]

14.0 BASEMENT FINISHING

.1 0 - 24% [17]

.2 25 - 49% [2]

.3 50 - 74% [3]

.4 75 - 99% [8]

.5 100% [2]

Total Number of samples = [32]

The following is the breakdown of the inspection results that would not fit into the inspection summary.

1. Item 6.50.4 Wall Deflections

   These are the deflections recorded:

   .1 2 3/4" on the 2*6 wall. There was one stud broken. The studs were "All-American" studs from Oregon. The studs had a high number of large knots in them and appear to be a stud grade. The studs were located under a raised patio deck with negative drainage. PWF study #21

   .2 1/2" - 3/4" on a 10'- 0" high wall. PWF study #22

2. Item 10.10.7 Main Floor Framing - Beams

   The following are the other beam types used:

   .1 There is a beam but due to the finishing of the basement we cannot tell what type it is. This applies to PWF study #'s: 5
   13
   14
   15
   18
   19

   .2 3 ply 2*8; PWF study # 17

3. Item 10.20.7 Main Floor Framing - Floor

   The following are the floor types used:

   .1 TTS floor joists; PWF study #15

   .2 2*8 @ 16" o.c.; PWF study #17

   .3 2*8 @ 16" o.c.; PWF study #25

4. Item 13.10.4 Sump Type

   The following are sump types used:

   .1 Custom made metal box

   .2 A sump box filled with washed rock constructed in the side of the hill and covered with fill. This was constructed about 20'-0" from the PWF and about 4'-0" below the bottom of the footing. PWF study #18

.3 During inspection we could not find these sumps. There was no way to determine if they were covered or just simply deleted during construction. This applied to PWF study #'s 14
15
28

## Appendix B Inspection and Sampling

Part II A Summary of the Chronological Breakdown of the Test Group.

The years in which the inspected PFW's were built are tabulated on page B13.

| YEAR OF CONSTRUCTION | NO. OF HOUSES |
|---|---|
| 1977 | 1 |
| 1978 | 1 |
| 1979 | 12 |
| 1980 | 3 |
| 1981 | 3 |
| 1982 | 0 |
| 1983 | 2 |
| 1984 | 0 |
| 1985 | 0 |
| 1986 | 6 |
| 1987 | 2 |
| UNABLE TO DETERMINE | 2 |
| Total | 32 |

## Appendix C Occupant Questionnaire

The pages in this appendix contain the questions that were asked in the questionnaire and summaries of the responses that were received. Where applicable our commentary has been provided in response to comments made by the person who completed the questionnaire.

## OCCUPANT QUESTIONNAIRE

1. When was your home built?
(See page C17 item 1 for breakdown of answers)

2. What year did you move into your residence?
(See page C17 item 2 for breakdown of answers)

3. Would you consent to an investigation of your basement by us at a time that would be convenient for you?

.1 [103] yes .2 [19] no

Total Number of Responses = [122]

4. If you consent to an inspection of the basement and wish to arrange a convenient time by phone, please provide a number, otherwise we will arrange a time by mail.
(Not applicable)

5. Do you own or rent your residence?

.1 [128] own .2 [1] rent

Total Number of Responses = [129]

6. What is the usual number of occupants living in the house?
(See page C17 item 3 for breakdown of answers)

Total Number of Responses = [126]

7. How did you choose to use a preserved wood foundation for your house?

.1 [28] on the advice of a friend
.2 [45] on the basis of advertisements in the paper or trade literature
.3 [14] chosen by the builder in consultation with you
.4 [9] already there when you bought the house
.5 [49] other See page C18 item 4 for breakdown of answers

Total Number of Responses = [145]

8. What were the main reasons for deciding to use a preserved wood foundation? (Check as many as apply to you).

.1 [46] cost
.2 [91] ease of finishing basement
.3 [12] past experience
.4 [8] not involved in the decision
.5 [71] other See page C18 item 5 for breakdown of answers

Total Number of Responses = [228]

9. Which of the following organizations/publications did you consult for details on preserved wood foundations?

.1 [21] Canadian Wood Council
.2 [9] Canadian Institute of Treated Wood
.3 [24] Canadian Standards Association
.4 [27] assumed the builder knew what he had to do
.5 [64] other information See page C19 item 6 for breakdown of answers

Total Number of Responses = [145]

10. How was the construction of your house managed?

.1 [13] by the builder
.2 [57] by yourself, employing a builder
.3 [60] by yourself, doing most of the building yourself
.5 [2.] other See page C18 item 7 for breakdown of answers

Total Number of Responses = [132]

11. How would you describe the comfort level in the basement living space?

.1 [0] uncomfortably humid
.2 [35] comfortably humid
.3 [88] comfortably dry
.4 [2] uncomfortably dry
.5 [9] no opinion

Total Number of Responses = [134]

12. If you have noted any odours in your basement, do they smell like (check as many as apply)

.1 [12] a new house
.2 [6] dust
.3 [2] fuel oil
.4 [0] smelly running shoes
.5 [5] pets
.6 [0] garlic
.7 [16] earthy or musty
.8 [31] same as upstairs
.9 [74] no smell noted
.10 [5] other See page C19 item 8 for breakdown of answers.

Total Number of Responses = [151]

13. Which of the following words best describe the living conditions in your basement during winter? (check as many as apply)

.1 [51] cosy
.2 [8] humid
.3 [9] cold
.4 [56] warm
.5 [4] drafty
.6 [67] pleasant
.7 [23] dry
.8 [1] stale
.9 [1] hot
.10 [63] even temperature
.11 [12] other

Total Number of Responses = [295]

14. What is the R-value of the house exterior wall?

| | | | | | |
|---|---|---|---|---|---|
| .1 | 8 | 10 - 15 | .4 | 16 | 30 - 40 |
| .2 | 24 | 15 - 20 | .5 | 9 | 40 - 50 |
| .3 | 65 | 20 - 30 | | | |

Total Number of Responses = 122

15. What type of windows are in the house?

| | | |
|---|---|---|
| .1 | 89 | wood double glazed |
| .2 | 21 | wood triple glazed |
| .3 | 8 | vinyl double glazed |
| .4 | 4 | vinyl triple glazed |
| .5 | 23 | aluminum or vinyl sliders |
| .6 | 6 | other See page C19 item 9 for breakdown of answers |

Total Number of Responses = 151

16. During cold weather does moisture appear on:

| | | | Yes | No |
|---|---|---|---|---|
| .1 | 56 | windows | 66 | 54 |
| .2 | 33 | window sills | | |
| .3 | 1 | skylights | | |

Total Number of Responses = 120

17. Which of the following mechanisms do you rely on for fresh air for your house?

| | | |
|---|---|---|
| .1 | 16 | air-to-air heat exchanger |
| .2 | 19 | forced fresh air fan with no heat recovery |
| .3 | 76 | natural ventilation (no special equipment) |
| .4 | 62 | windows |

Total Number of Responses = 173

18. Which of the following do you rely on for providing adequate humidity during the winter?

| | | |
|---|---|---|
| .1 | 53 | humidifier on the furnace |
| .2 | 23 | stand-alone humidifier |
| .3 | 51 | no humidifier |

Total Number of Responses = 127

19. If you have a humidifier on the furnace is it controlled by a humidistat?

| | | |
|---|---|---|
| .1 | 40 | yes |
| .2 | 30 | no |

Total Number of Responses = 70

20. Is part or all of the house air conditioned in the summer time?

.1 [2] one or two window air conditioners used
.2 [1] central air conditioning used
.3 [124] no air conditioning used

Total Number of Responses = [127]

21. How do you dry your clothing?

.1 [115] use a clothes dryer most or all of the time
.2 [24] hang clothes to dry outside in the summer
.3 [4] hang clothes to dry inside in the winter

Total Number of Responses = [143]

22. If you use a clothes dryer is the dryer vented to the outside?

.1 [119] yes
.2 [7] no

Total Number of Responses = [126]

23. Where is your clothes dryer located?

.1 [53] main floor
.2 [6] third level on a split
.3 [68] basement
.4 [0] do not have one

Total Number of Responses = [127]

24. Which of the following heating systems do you have? (check all systems that apply)

.1 [94] oil or gas fired forced air furnace with a chimney
.2 [14] oil or gas fired forced air high efficiency furnace with no chimney
.3 [2] electrical baseboard heating
.4 [2] electrical furnace with forced air
.5 [0] heat pump with conbustion heating back-up
.6 [0] heat pump with combustion heating back-up
.7 [37] wood burning fireplace
.8 [24] wood burning stove
.9 [1] solar heating
.10 [17] hot water heating
.11 [14] air-to-air heat exchanger

Total Number of Responses = [205]

25. Is there a fresh air supply from outside provided for any of your combustion heating devices?

.1 [107] yes .2 [12] no 3. [6] don't know

Total Number of Responses = [125]

26. What combustion appliances do you have?

.1 [12] gas stove
.2 [15] gas dryer
.3 [55] none at all
.4 [41] other See page C19 item 10 for breakdown of answers

Total Number of Responses = [123]

27. Do these appliances have their own combustion air?

.1 [33] yes .2 [28] no

Total Number of Responses = [61]

28. Which of the following do you have in your basement?

| | | Yes |
|---|---|---|
| .1 | bedrooms used on a daily basis | [45] |
| .2 | bedrooms used occasionally | [66] |
| .3 | rumpus, family or activity room | [96] |
| .4 | furnace and utility room | [118] |
| .5 | laundry room | [65] |
| .6 | heated storage room | [61] |
| .7 | cold storage room | [68] |
| .8 | bathroom | [83] |
| | If yes, does it have | |
| .8a | a shower cabinet | [50] |
| .8b | a tub/shower combination | [24] |
| .8c | a tub only | [2] |
| .9 | children's play room | [49] |
| .10 | office | [39] |
| .11 | other (please specify) | [29] |

.11a See page C20 item 11 for breakdown of answers
.11b See page C20 item 11 for breakdown of answers
.11c See page C20 item 11 for breakdown of answers
.11d See page C20 item 11 for breakdown of answers
.11e See page C20 item 11 for breakdown of answers
.11f See page C20 item 11 for breakdown of answers

Total Number of Responses = [794]

29. How many levels does your wood basement have?

.1 [119] the whole basement is at the same level
.2 [9] there are two levels
.3 [0] there are more than two levels

Total Number of Responses = [128]

30. How many lineal feet of foundation walls are there, i.e. what is the perimeter of the house? (insert the number of feet in the spaces provided)
(See page C20 item 12 for breakdown of answers)

Total Number of Responses = [110]

31. How many corners are there in the outside perimeter of the house? (For example, a simple rectangular plan would have 4 corners. Other more complex shapes could have 6, 8 or more corners. Count a corner for each place that a foundation wall changes direction and insert the number in the spaces provided.)
(See page C21 item 13 for breakdown of answers)

Total Number of Responses = [126]

32. What is the maximum number of stories carried by the preserved wood foundation? (Count each floor level above the basement)

.1 [3] no additional stories
.2 [96] 1 storey
.3 [28] 2 stories
.4 [1] 3 stories

Total Number of Responses = [128]

33. To what degree have the preserved wood foundation walls been finished? (with paneling, gypsum drywall, or other panel materials)

.1 [10] not at all
.2 [18] partly
.3 [28] mostly
.4 [73] completely finished

Total Number of Responses = [129]

34. If some finishing of the preserved wood wall has been done, which of the following materials has been used? (check all applicable boxes)

.1 [104] gypsum board
.2 [29] wood produce paneling
.3 [100] plastic vapour barrier

.4 [105] insulation (full thickness)
.5 [6] insulation (partial thickness)
.6 [0] other See page C21 item 14 for breakdown of answers

Total Number of Responses = [344]

35. Before backfilling of the soil against the foundation, were the joints between the plywood sheets caulked?

.1 [113] yes .2 [3] no .3 [11] don't know

Total Number of Responses = [127]

36. Before the backfilling of the soil against the foundation, some form of damp proofing is usually applied to the foundation walls to inhibit moisture from the soil from coming into the foundation. What type was used for your foundation below the ground line?

.1 [78] plastic sheeting
.2 [70] asphalt coating
.3 [11] resin coating
.4 [7] don't know
.5 [5] other See page C22 item 15 for breakdown of answers

Total Number of Responses = [171]

37. If insulation was applied to the outside of the basement wall, what type was used?

.1 [10] rigid plastic foam
.2 [3] semi-rigid fibre insulation
.3 [82] none on the outside
.4 [7] don't know
.5 [1] other See page C2 item 16 for breakdown of answers

Total Number of Responses = [103]

38. How is the exterior of the preserved wood foundation finished from the first floor level to soil level?

.1 [9] brick extends to soil
.2 [79] cement parging
.3 [0] asbestos cement board
.4 [7] paint or other coating
.5 [49] other See page C21 item 17 for breakdown of answers

Total Number of Responses = [144]

39. What is the outside finish of the outside walls on the first floor level above the basement level? (check as many of the types below as apply)

.1 [41] hardboard siding

.2 [10] aluminum or steel siding
.3 [36] vinyl siding
.4 [22] brick or stone veneer
.5 [25] stucco
.6 [4] plywood siding
.7 [25] other See page C22 item 18 for breakdown of answers

Total Number of Responses = [163]

40. Concerning the support for the wood foundation, is the foundation located?

.1 [78] primarily on soil
.2 [39] primarily on rock
.3 [8] don't know

Total Number of Responses = [125]

41. When the wood foundation was built, were the walls placed on

.1 [43] a concrete footing pad
.2 [80] a gravel layer over the soil
.3 [3] don't know
.4 [4] other See page C22 item 19 for breakdown of answers

Total Number of Responses = [130]

42. Did construction of the preserved wood foundation take place entirely or partly during a winter period?

.1 [18] yes .2 [104] no .3 [6] don't know

Total Number of Responses = [128]

43. Was the foundation exposed to the weather for an extended period before construction of the remainder of the house?

.1 [77] less than 1 month
.2 [18] 1 - 2 months
.3 [15] 2 - 4 months
.4 [6] more than 4 months
.5 [9] don't know

Total Number of Responses = [125]

44. If you are aware of the conditions of the preserved wood foundation at time of construction (including the time the superstructure or part of it was constructed), was the excavation

.1 [19] wet
.2 [50] well drained even though rain fell
.3 [53] dry
.4 [4] frozen
.5 [3] other See page C23 item 20 for breakdown of answers

Total Number of Responses = [129]

45. What construction is used in the basement or lowest floor? (Check as many as are used)

.1 [12] a suspended wooden floor (a wooden floor with a crawl space underneath)
.2 [29] a wooden sleeper floor (where the floor joists or sleepers rest directly on ground)
.3 [88] a poured concrete floor slab
.4 [1] don't know

Total Number of Responses = [130]

46. If the basement floor is of wooden construction, is there (check as many as apply)

.1 [29] a gravel or sand bed below it
.2 [34] a moisture barrier consisting of plastic or building paper
.3 [28] crushed rock
.4 [1] cannot determine what is under the floor

Total Number of Responses = [92]

47. Was there a weeping tile drain installed at the base of the foundation around the perimeter of the house?

.1 [39] yes .2 [80] no .3 [7] don't know

Total Number of Responses = [126]

48. What backfilling material was used to fill in the excavation against the preserved wood foundation (not counting top soil that might have been put on for grass)

.1 [90] gravel or sand
.2 [21] silty soil
.3 [33] clay
.4 [5] don't know

Total Number of Responses = [149]

49. How high is the maximum soil height above the basement floor?

.1 [3] under 3 feet
.2 [30] 3 to 4 feet
.3 [41] 4 to 5 feet
.4 [29] 5 to 6 feet
.5 [19] 6 to 7 feet
.6 [12] 7 to 8 feet
.7 [1] over 8 feet

Total Number of Responses = [135]

50. How high is the maximum soil height above the basement floor.

| | | | | | |
|---|---|---|---|---|---|
| .1 | 12. | the basement floor is at or above grade | | | |
| .2 | 2 | from 1 to 2 feet | .6 | 24 | from 5 to 6 feet |
| .3 | 2 | from 2 to 3 feet | .7 | 4 | from 6 to 7 feet |
| .4 | 41 | from 3 to 4 feet | .8 | 1 | from 7 to 8feet |
| .5 | 40 | from 4 to 5 feet | .9 | 0 | over 8 feet |

Total Number of Responses = 126

51. How high are the preserved wood foundation walls?

| | | | | | |
|---|---|---|---|---|---|
| .1 | 2 | 4 to 6 feet | .4 | 19 | 8 to 9 feet |
| .2 | 10 | 6 to 8 feet | .5 | 18 | over 9 feet |
| .3 | 90 | 8 feet | | | |

Total Number of Responses = 139

52. Is the house constructed on terrain that is

| | | |
|---|---|---|
| .1 | 45 | sloped |
| .2 | 83 | mostly flat |
| .3 | 0 | other See page C22 item 21 for breakdown of answers |

Total Number of Responses = 128

53. Does the ground slope away from the house all around?

| | | |
|---|---|---|
| .1 | 74 | yes |
| .2 | 17 | level all around |
| .3 | 24 | yes, except on one side where it is level |
| .4 | 15 | yes, except a few places where it slopes toward the house |
| .5 | 0 | no, slope is generally toward the house all around |

Total Number of Responses = 130

54. Does the ground slope away from the house all around?

| | | |
|---|---|---|
| .1 | 73 | no |
| .2 | 44 | partly (on one side or corner) |
| .3 | 9 | yes (all around) |

Total Number of Responses = 126

55. If there is a lake or stream nearby, what is the level of the body of water relative to the basement floor?

| | | | | | |
|---|---|---|---|---|---|
| .1 | 5 | within 3 feet | .4 | 17 | greater than 10 feet |
| .2 | 3 | between 3 and 5 feet | .5 | 6 | cannot estimate |
| .3 | 4 | between 5 and 10 feet | .6 | 82 | no lake or stream |

Total Number of Responses = 117

56. If there is a lake or stream nearby, what is the distance of the body of water from the foundation?

| | | | | | |
|---|---|---|---|---|---|
| .1 | 1 | 0 to 50 feet | .4 | 8 | 200 to 500 feet |
| .2 | 2 | 50 to 100 feet | .5 | 7 | 500 to 1000 feet |
| .3 | 4 | 100 to 200 feet | .6 | 23 | over 1000 feet |

Total Number of Responses = 45

57. If you have a sump pump, when was it installed?

| | | |
|---|---|---|
| .1 | 37 | at time of construction |
| .2 | 2 | after you moved in |
| .3 | 71 | not at all |

Total Number of Responses = 110

58. If you have a sump pump, when does it operate more frequently?

| | | |
|---|---|---|
| .1 | 0 | winter |
| .2 | 18 | spring |
| .3 | 11 | summer |
| .4 | 1 | autumn |
| .5 | 1 | about the same all year round |
| .6 | 38 | not at all |

Total Number of Responses = 69

59. What is the distance in inches from the basement floor to the water level in the sump pump?
(See page C23 item 22 for breakdown of answers)

Total Number of Responses = 69

60. Where there any water leaks into the basement after you moved in?

.1 9 yes .2 116 no .3 1 don't know

Total Number of Responses = 126

61. Have you had any serious flooding in the basement?

| Yes | No |
|---|---|
| 7 | 99 |

If yes, what was the reason for this flooding?

| | | |
|---|---|---|
| .1 | 3 | blocked drain |
| .2 | 3 | back |
| .3 | 0 | general flood conditions outside |

.4 [0] flooding but don't know cause
.5 [18] no flooding
.6 [3] other See page C23 item 23 for breakdown of answers

Total Number of Responses = [107]

62. Have you had any water problems in your basement that were not the result of water or sewer line leakage?

.1 [7] yes .2 [121] no

Total Number of Responses = [128]

63. If there were any leaks, how were they repaired?

.1 [4] leaks not repaired yet
.2 [3] excavation of soil outside and recaulking
.3 [2] attemt to fix leak from inside
.4 [1] other See page C23 item 24 for breakdown of answers

Total Number of Responses = [10]

64. Have you experienced any of the following problems in your home?

| | | Yes | No |
|---|---|---|---|
| .1 | doors sticking | [39] | [88] |
| | If yes, did this occur on | | |
| | .1a basement floor level | [8] | |
| | .1b main floor level | [32] | |
| | .1c second floor level | [4] | |
| | .1d other See page C23 item 25 for breakdown of answers | [3] | |

Total Number of Responses = [127]

| | | Yes | No |
|---|---|---|---|
| .2 | cracking in the ceiling drywall | [27] | [100] |
| | If yes, did this occur on | | |
| | .2a basement level | [0] | [100] |
| | .2b main floor ceiling | [22] | |
| | .2c second floor ceiling | [6] | |
| | .2d other See page C23 item 25 for breakdown of answers | [0] | |

Total Number of Responses = [127]

| | | Yes | No |
|---|---|---|---|
| .3 | cracking of the drywall on the walls. | 28 | 99 |

If yes, did this occur on

| | | |
|---|---|---|
| .3a | basement walls | 4 |
| .3b | main floor | 23 |
| .3c | second floor | 7 |
| .3d | other See page C24 item 25 for breakdown of answers | 2 |

Total Number of Responses = 127

| | | | |
|---|---|---|---|
| 4. | movement of attached garage | 5 | 121 |

Total Number of Responses = 126

65. Have you experienced any of the following problems with the basement floor of your residence?

| | | Yes | No |
|---|---|---|---|
| .1 | settling | 8 | 120 |
| .2 | heaving | 4 | 124 |
| .3 | cracking if floor is concrete | 27 | 101 |
| .4 | separating if floor is wood | 1 | 127 |

Total Number of Responses = 512

66. How many people do you know of that have a house built on a preserved wood foundation?

| | | |
|---|---|---|
| .1 | 22 | 0 |
| .2 | 74 | 1 to 5 |
| .3 | 15 | 5 to 10 |
| .4 | 16 | more than 10 |

Total Number of Responses = 127

67a. Do any of the above people have problems with their preserved wood foundation?

| | | | |
|---|---|---|---|
| .1 | 9 | yes | |
| .2 | 88 | no | |
| .3 | 1 | | |
| .4 | 0 | | |

Total Number of Responses = 98

67b. How would you rate the finishability of your preserved wood foundation compared to a concrete basement as it relates to

| | | easier | more difficult |
|---|---|---|---|
| .1 | exterior of wall above grade | 100 | 24 |
| .2 | installation of windows | 117 | 7 |
| .3 | insulating | 123 | 1 |
| .4 | installing air/vapour barrier | 121 | 3 |
| .5 | installing finish paneling | 122 | 2 |

Total Number of Responses = 620

68. Have you had to pay extra for homeowner's insurance because you have a preserved wood foundation?

.1 1 yes 2. 95 no .3 32 don't know

Total Number of Responses = 128

69. Have you heard any statements indicating that the resale value of your home may be lower because you have a preserved wood foundation?

.1 17 yes .2 92 no .3 19 don't know

Total Number of Responses = 128

70. Concerning the performance of the preserved wood foundation basement during your occupancy, how would you rate it relative to basements of other houses you have lived in?

.1 0 worse
.2 13 about the same
.3 102 better
.4 13 no opinion

Total Number of Responses = 128

71. Would you recommend to your acquaintances that they construct a preserved wood foundation?

.1 121 yes
.2 7 no

Total Number of Responses = 128

72. If you were to build a new home tomorrow, would you use a preserved wood foundation?

.1 119 yes
.2 8 no

Total Number of Responses = 127

73. Comments or suggestions concerning preserved wood foundations.
(See pages C24 item 26 for breakdown of answers)

The following are the summaries of the responses to specific questions as noted.

1. The following is the breakdown of the number of responses for each of the calendar years given in question 2.

| Year of construction | | Number of Responses |
|---|---|---|
| .1 | 1912 | 2 |
| .2 | 1919 | 1 |
| .3 | 1950 | 1 |
| .4 | 1952 | 1 |
| .5 | 1956 | 2 |
| .6 | 1977 | 1 |
| .7 | 1978 | 6 |
| .8 | 1979 | 17 |
| .9 | 1980 | 11 |
| .10 | 1981 | 20 |
| .11 | 1982 | 12 |
| .12 | 1983 | 14 |
| .13 | 1984 | 13 |
| .14 | 1985 | 9 |
| .15 | 1986 | 14 |
| .16 | 1987 | 2 |
| No Response | | 2 |

Total Number of Responses = 128

2. The following are the responses given in question 2.

| Year Moved In | | Number of Responses |
|---|---|---|
| .1 | 1969 | 1 |
| .2 | 1971 | 1 |
| .3 | 1975 | 1 |
| .4 | 1976 | 1 |
| .5 | 1978 | 6 |
| .6 | 1979 | 12 |
| .7 | 1980 | 13 |
| .8 | 1981 | 19 |
| .9 | 1982 | 9 |
| .10 | 1983 | 18 |
| .11 | 1984 | 10 |
| .12 | 1985 | 14 |
| .13 | 1986 | 15 |
| .14 | 1987 | 6 |
| No Response | | 2 |

Total Number of Responses = 128

3. The following are the responses given in question 6.

| Number of Occupants | | Number of Responses |
|---|---|---|
| .1 | varies | 1 |
| .2 | 1 | 1 |

| | | |
|---|---|---|
| .3 | 2 | 23 |
| .4 | 3 | 19 |
| .5 | 4 | 38 |
| .6 | 5 | 31 |
| .7 | 6 | 7 |
| .8 | 7 | 1 |

Total Number of Response = 126

4. The following are the responses given to question 7.5 (other).

| Response Given | | |
|---|---|---|
| .1 | based on knowledge required from CHAP | 11 |
| .2 | advice of family | 1 |
| .3 | general acquaintance with them (PWF's) | 7 |
| .4 | researched idea ourselves | 5 |
| .5 | presentation by woodway basements | 1 |
| .6 | case of future development | 1 |
| .7 | cost | 2 |
| .8 | build it themselves | 2 |
| .9 | used in previous home | 3 |
| .10 | from building course | 2 |
| .11 | personal beliefs in product | 6 |
| .12 | didn't like concrete | 2 |
| .13 | energy efficiency | 4 |
| .14 | referred by Alberta Dept. of Agriculture | 1 |
| .15 | recommended by Engineer | 1 |

Total Number of Responses = 49

5. The following are the responses given to question 8.5 (other).

| Resonse Given | | |
|---|---|---|
| .1 | energy efficient | 6 |
| .2 | able to build myself | 14 |
| .3 | warmth | 27 |
| .4 | faster to build | 2 |
| .5 | concrete not available | 1 |
| .6 | easier winter construction | 1 |
| .7 | adapt foundation to site | 2 |
| .8 | convenience | 1 |
| .9 | ease of construction and better insulation | 13 |
| .10 | to get away from damp walls | 3 |
| .11 | on advice of others/ literature | 1 |

Total Number of Responses = 71

6. The following are the responses given to question 9.5 (other).

| Response Given | | |
|---|---|---|
| .1 | Engineer | 10 |
| .2 | Brown Engineering | 17 |
| .3 | CHAP | 5 |
| .4 | Alberta Dept. of Agriculture | 3 |

| | | |
|---|---|---|
| .5 | CMHC | 1 |
| .6 | curious/ wanted to try it | 1 |
| .7 | general literature | 7 |
| .8 | not involved with the building | 3 |
| .9 | did not consult | 1 |
| .10 | Nelson Homes | 1 |
| .11 | paper ad | 1 |
| .12 | past owners | 4 |
| .13 | trade show | 1 |
| .14 | Revelstoke/ lumber yard | 5 |
| .15 | contractor | 3 |
| .16 | NAIT information | 1 |

Total Number of Responses = 64

7. The following are the responses given to question 10.5 (other).

Responses Given

| | | |
|---|---|---|
| .1 | do not know | 1 |
| .2 | past owner | 1 |

Total Number of REsponses = 2

8. The following are responses given to question 12.10 (other).

Resonses Given

| | | |
|---|---|---|
| .1 | faint, acrid smell, we understand it is from particle board on walls | 1 |
| .2 | tar and caulking | 1 |
| .3 | stagnant water | 1 |
| .4 | odd wood smell/ sawdust | 2 |

Total Number of Responses = 5

9. The following are the responses given to question 15.6 (other).

Responses Given

| | | |
|---|---|---|
| .1 | aluminum 'storefront' | 1 |
| .2 | wood casement | 2 |
| .3 | aluminum sliding door | 1 |
| .4 | have not installed them yet | 1 |
| .5 | aluminum triple glazed | 1 |

Total Number of Responses = 6

10. The following are the responses given to question 26.4 (other).

Responses Given

| | | |
|---|---|---|
| .1 | water heater | 26 |
| .2 | furnace | 3 |
| .3 | fireplace | 2 |
| .4 | furnace and water heater (gas) | 9 |
| .5 | wood stove | 1 |

Total Number of Responses = 41

11. The following are the responses given to question 28.11a to f.

| Responses Given | |
|---|---|
| .1 workshop | 14 |
| .2 living room | 1 |
| .3 bar | 1 |
| .4 sewing room | 4 |
| .5 basement entry | 2 |
| .6 hobby room | 2 |
| .7 complete kitchen | 2 |
| .8 crawl space | 4 |
| .9 sauna | 5 |

Total Number of Responses = 35

12. The following are the responses given to question 30.

| Lineal Feet of Foundation Wall | |
|---|---|
| .1 95-100 | 3 |
| .2 101-105 | 1 |
| .3 106-110 | 1 |
| .4 111-115 | 0 |
| .5 116-120 | 3 |
| .6 121-125 | 2 |
| .7 126-130 | 8 |
| .8 131-135 | 11 |
| .9 136-140 | 13 |
| .10 141-145 | 7 |
| .11 146-150 | 11 |
| .12 151-155 | 5 |
| .13 156-160 | 12 |
| .14 161-165 | 9 |
| .15 166-170 | 0 |
| .16 171-175 | 0 |
| .17 176-180 | 6 |
| .18 181-185 | 2 |
| .19 186-190 | 3 |
| .20 191-195 | 2 |
| .21 196-200 | 2 |
| .22 201-205 | 1 |
| .23 214 | 1 |
| .24 220 | 1 |
| .25 230 | 1 |
| .26 240-245 | 2 |
| .27 254 | 1 |
| .28 264 | 1 |
| .29 300 | 1 |

Total Number of Responses = 110

13. The following are the responses given to question 31.

| | | |
|---|---|---|
| .1 | 4 | 45 |
| .2 | 5 | 4 |
| .3 | 6 | 38 |
| .4 | 7 | 2 |
| .5 | 8 | 21 |
| .6 | 9 | 1 |
| .7 | 10 | 6 |
| .8 | 11 | 2 |
| .9 | 12 | 3 |
| .10 | 14 | 4 |

Total Number of Responses = 126

14. The following are the responses given to question 34.6 (other).

Responses Given

No response given to this question.

15. The following are the responses given to question 36.5 (other).

Responses Given

| | | |
|---|---|---|
| .1 | cardboard | 1 |
| .2 | base clad insulation | 1 |
| .3 | 1" blue styrofoam insulation | 1 |
| .4 | weeping tile | 1 |
| .5 | plastic and water proof insulation | 1 |

Total Number of Responses = 5

16. The following are the responses given to question 37.5 (other).

Responses Given

| | | |
|---|---|---|
| .1 | rigid at garage wall | 1 |

Total Number of Responses = 1

17. The following are the responses given to question 38.5 (other).

Responses Given

| | | |
|---|---|---|
| .1 | wood siding above exposed plywood | 10 |
| .2 | stucco | 3 |
| .3 | cedar siding | 9 |
| .4 | artificial rock | 1 |
| .5 | metal siding | 4 |
| .6 | none | 1 |
| .7 | vinyl siding | 16 |
| .8 | not finished yet | 3 |
| .11 | stain | 2 |

Total Number of Responses = 49

18. The following are the responses given to question 39.7 (other).

Resonses Given

| | | |
|---|---|---|
| .1 | cedar siding | 19 |
| .2 | vertical wood boards | 2 |
| .3 | pressed wood siding | 1 |
| .4 | log | 1 |
| .5 | none | 1 |
| .6 | stain | 1 |

Total Number of Responses = 25

19. The following are the responses given to question 41.4 (other).

Responses Given

| | | |
|---|---|---|
| .1 | concrete piles | 1 |
| .2 | PWF footer (multi-layered) | 3 |

Total Number of Responses = 4

20. The following are the responses given to question 44.5 (other).

Responses Given

| | | |
|---|---|---|
| .1 | in clay but rain dumped out using sump pump | 1 |
| .2 | don,t know | 2 |

Total Number of Responses = 3

21. The following are the responses given to question 52.3 (other).

Responses Given

No response given to this question.

22. The following are the responses given to question 59

Responses Given

| | | |
|---|---|---|
| .1 | dry | 12 |
| .2 | 0-5 | 4 |
| .3 | 6-10 | 1 |
| .4 | 11-15 | 6 |
| .5 | 16-20 | 8 |
| .6 | 21-25 | 9 |
| .7 | 26-30 | 4 |
| .8 | 31-40 | 4 |
| .9 | 41-60 | 3 |
| .10 | 61-80 | 1 |

Total Number of Responses = 52

23. The following are the responses given to question 61.6 (other).

Responses Given

| | | |
|---|---|---|
| .1 | poor drainage slope at surface on inside corner | 1 |
| .2 | incorrect hook-up of weeping tile | 1 |
| .3 | sump failure | 1 |

Total Number of Responses = 3

24. The following are the responses given to question 63.4

Responses Given

| | | |
|---|---|---|
| .1 | small leak on base plate sealed by wood expansion | 1 |

Total Number of Resonses = 1

25. The following are the responses given to question 64.1d, .2d and .3d (other).

Responses Given

| | | |
|---|---|---|
| .1 | one corner in basement | 1 |
| .2 | around window frames | 1 |
| .3 | entrance of bilevel | 2 |
| .4 | house was lifted onto PWF | 1 |

Total Number of Responses = 5

26. The following are the responses given in question 73.

1. One of neighbours has a wood foundation, engineered by you- but in cutting costs, e.g. pit run gravel under their cement floor and no poly under their floor- they have had more water in their sump than we have. (33)

2. They are a pain to have built. You have to backfill very carefully. The inspectors are the worst as you have to wait and pay for an engineer, and also wait for the city to inspect. Tying in the garage floor to the walls cannot be done, or bolting angle irons in for a brick front. The extra inspections result in delays to backfilling and thereby to the resumption of the construction of the top floor. I found with our first wooden basement, the engineers differed in their opinions regarding the reinforcement of the wall between the garage and basement. (36)

3. We love it. If possible, we'd never have concrete again. We'd probably use an engineer again if we constructed our own P.W.F. again. (38)

4. Our first wood basement home, we built in 1981. We lived there 5 years and had no problems with the basement. It was a bilevel type with 4' backfill, concrete footings, poured slab floor with under slab heat. The basement was completely finished and was as comfortable as the main floor. (48)

5. I would use cement footings rather than P.W.F. plates on gravel because of the problems I encountered in leveling walls during construction. Otherwise I woundn't even consider not using wood again. (49)

6. Finishing was much easier and no forms needed for cement. (55)

7. These basements are excellent. I feel they are very superior to concrete in a number of ways. (56)

8. I would use concrete footings instead of sleepers laying on gravel. Easier to level out foundation when starting. (58)

9. If properly constructed wood foundations are trouble free. Water problems in the basements of our neighbours (concrete foundations) have been encountered, but no problems with water in our basement. (67)

10. At the time of building I probably would not have put in the foundation myself if I could have found a contractor to install to a point ready for backfill. In the design we had headers built into the walls for window opening, this required the window top to be 1' below the top of the foundation which made window wells necessary and limited the size of the windows. (68)

11. I have heard the solution used on the wood to preserve it, is harmful to human beings. (reply please) I also wonder how long until the outside skin of plywood will rot through? ( 69)

12. High construction standards must be maintained as a deterioration of these standards could detract from the performance of the P.W.F. finished product. Site selection and finished grades around the house are also important. I would be interested in receiving a copy of your report or having an opportunity to look at it. (72)

13. I wouldn't have any other kind of foundation. (70)

14. We beleive our wood basement is warmer and a lot easier to finish. We like it very much. We insulated with R-20 from header to plate and were told we should have a 'R' value of 28 to 30. (73)

14. I have experience bowing of the walls with wood foundations which result in having trouble attaching partitioning walls in the basement. If I was to build again I would insist on closer spacing of studs or doubling every second stud on walls of longer lengths than 15'. My walls have a 1/2" to 1 1/2" bow depending on the length of the walls where there is no other support. This problem seems to be very frequent for wood foundations and my feeling is that this is grounds for future problems. Most people will not own up to this problem for it would affect the resale value of their homes. (79)

15. The only negative aspect of a wood foundation is that it was more expensive than concrete. (82)

16. There seems to be a leak somewhere between where the main body of the house attaches to the attached garage. Water has leaked in through drywalling to concrete pad. During construction ther was a noticeable sag of garage door opening towards the centre of the house. This was re-excavated, a portion of basement cement pad jack-hammered out, and supposedly fixed, but soon after we moved in, water started leaking in. This is the only problem, I'm not sure of the cause, but would sure appreciate a visit from your experts! Thank-you. (83)

17. With regard to questions 57-59, we do not have a sump pump but do have a sump hole. We feel it should require more bracing to guard against hydrostatic pressure. (84)

18. This is my third P.W.F. home and it seems to me there is too much settling after drywall and shingles. Possibly concrete footings are the answer. (87)

19. Only concerns I have might be 20 years from now. So far we are very pleased with our wood basement. We do have ants along the south side of our basement, could they possibly do damage? (88)

20. I am extremely satisfied, I would never build a concrete basement. I hope more people build with wood basements in the future. I hope this helps in your survey. (91)

21. More consumer information should be available. How many wood basements are there in Alberta? How old is the oldest? What is the life expectancy? What problems can we expect? If you have this info., please send some of it to us, as we do have several inquiries a year. (93)

22. In my opinion my basement should have been designed stronger. For example; I am noticing bending of the foundation inwards beside the windows. There were only 2 studs on each side of the windows in the design. If I were to do it again I would probably put 4 of them in. Also, possibly instead of 16" centers I would use 12" centers all around the perimeter. (95)

23. Extremely pleased with P.W.F. Engineer was most helpful. (100)

24. I think they are excellent to build, finish and to live in. (101)

25. Concerning question 50, I have a basement entrance so at the doorway and at an angle along one wall there is from 0'-4' of dirt above the basement floor. During construction the factory pre-fabbed wood foundation was altered so it would sit on the concrete perimeter footing instead of extending four feet below grade at the doorway. We then supported the footing with four feet of concrete. The bearing walls are on concrete pads with a treated 2" x 6" resting on the concrete. The concrete floor was then poured around these walls. The floor rests on about 6" of sand. We have had ants come into the basement alongside the bearing walls. They bring up material which appears to be sand. They have also appeared at the perimeter. They were poisoned each time they appeared but they have appeared numercus times. (102)

26. Only time will tell. (103)

27. Trouble free. (105)

28. Much more practical than concrete foundations. I would use a wood sleeper floor rather than a concrete slab if I were to do it again. (106)

29. The only negative thing I've heard about wooden basements is that the formaldehyde in the wood releases gases into the air we breathe. (107)

30. According to the instructions given to us on the construction of the basement, the results would have been a swimming pool; so we therefore finished the walls and roof prior to vapour barrier, wood sleeper floor and backfilling. We had an excessive amount of rainfall at the time of construction so we were compelled to use an alternative to the plans given to us. (108)

31. Do not build over a long winter period- freezing and expanding causes leveling problems. Build only on concrete footings, internal support should be adjustable jack posts, not a bearing wall due to inconsistancy in settling. (exteriorto interior) External drainage or backfill on the immediate exterior wall could be acheived more cheaply and more consistant by the application and fixing of a wire mesh 4" from the wall and then filling the space with washed rock. The top could then be capped and a good drainage would remain during backfill as well as after. (109)

32. I would also recommend to have the basement floor done with preserved wood, because of concrete cracking and coolness and concrete's musty odour. (110)

33. Terry- it was interesting filling this form out as it seems like only last month we built this home. Bob was really busy so I filled it in with his comments. All the best on your survey. Our house is currently up for sale and we will build wood again.

34. Where we put metal insulated siding we were afraid the basement wall would not be able to "breathe", so I drilled two or three 1/2" holes in the upper plate between every stud. I look forward to hearing from you. (116)

35. All around performance, I would say it is better than concrete especially in our cold climate. (117)

36. We put plastic on the outside of our basement walls, on our carpenters advice, and our neighbours used tar. I would like to know what is the best method and I think the builder should be made aware. Anyone that I asked didn't really know. My carpenter did say we couldn't use plastic and tar together because the tar would just eat the plastic. (125)

37. There are still alot of people who don't believe in preserved wood foundations. They are still using concrete. Most people feel they will not-however we have confidence in the information we have gathered over the years- on the positive features of a preserved wood foundation. There should be more educational material available on preserved wood foundations- most people are very skeptical of them and very few are using them. Send out some positive findings etc.- you have to prove to people that they will last for 100 years or whatever. They have to be convinced with reliable facts. I will be interested to hear the comments you have received- Also would appreciate the latest information and reports on preserved wood foundations. (126)

38. I would recommend a P.W.F. basement to anyone; we are totally pleased. The only reservations I might have is if I were building a house in a low area with a high water table. The 2" x 8" plank footing plate has supported the weight very well with literally no settling. Levelling the 2- level footing plate was difficult. If I had to do that over again I would consider a concrete footing. My brother built a log house on a wooden basement which we beefed- up from my engineered plans. The basement is supported by a 2" x 10" footing plate with 2" x 8" studs at 12" centers. The house is a single storey solid log wall consisting of 9 rounds of 14" logs. Ground level on one side is a full 8 feet and zero on the other side with a 4' sunken section of the 12" wall. No problems have been encountered. You would be welcome to inspect this basement as well. (129)

39. Wall studs warping before construction. Care to be taken during backfilling. e.g. 1. Proper filter soil. 2. Operator cannot get to close. 3. No rocks larger than 0.10m. There should be proper drainage under the floor. Special care to be taken at window incasements, supports and cornering. Probably a few I cannot think of, but we still would not have a concrete basement. I noticed that the neighbors wood basement used only 2 mil plastic sheeting, no tarring and did not even tar the nails, and they have more water problems than we do but not sure if it came through. I sure would like to know why there is a musty smell. I thought it came from the sump pump at first but not so sure now. We have a double wide trailer on the basement. (130)

40. It is warmer and drier. We bought a four year old house and had it moved out onto our wood foundation. Old house only had a cellar. (132)

41. I would urge people putting an asphalt coating on the outside below ground rather than plastic sheeting. The plastic has a tendency to slip down with the soil, in settling. (133)

42. I have built 2 other wood basements for rental houses, since our own, and so far have had no problems. Those two units have concrete floors, and forced air heating. (134)

43. In my opinion wood foundations are the way to go, providing the soil conditions and water table are also right. Secondly- preserved wood foundations should be engineered and constructed properly to prevent future problems. (135)

44. Its still standing, it could outlast me. Moved house out for son /86 put on wood also. (136)

45. Warm, relatively easy to work with. No trouble to finish- especially since it was exposed at times during construction. Great not to have to build a frame wall inside for stuffing insulation. In view of new health studies, we question the safety of the wood treatment (e.g. "Penta") during use (i.e. carcinogens) in construction. We did not install drainage weeping tiles or sump pump, even though recommended in your literature, as this area is excellent gravel/ rock drainage. We seem to recall some note about the guarantee pertaining to this- perhaps installation and guarantee of the above could be related to the soil/ area in which the house is being constructed. (137)

46. We are extremely pleased and would like to read the results of this survey and the tests done in our house this summer. (138)

47. We have a problem with cold in winter due to the basement floor being at or above grade on one side. It will probably require insulation applied to the exterior below ground level. Also one side wall is being pushed in by the pressure of the soil. There is no problem with the other side. (135)

48. They should get more publicity. It would appear many people don't know about them. They are very comfortable even though ours is not finished yet. (141)

49. My wood foundation has only 6 mil poly to protect it. I would like to see more protection in this area. (142)

50. If I were to build again the only thing about our preserved wood basement I would do differently would be to have a preserved wood floor as well as walls. Thusly skipping the concrete altogether. (143)

51. I am concerned about the chemicals used to preserve the wood. (145)

52. Much simpler and faster to build. It is warm, and easy to finish interior walls. I have no complaints about wooden basements. (148)

53. Wood basements require less heat- large energy savings. Walls are always warm-not cold and damp like cement. Original house, 24' x 28' is on cement foundation with vapour barrier, insulation and finished walls. Addition 24' x 28'-1/2 crawlspace -1/2 bedroom and basement entrance. The cement side has 5 heat ducts, the wood side has 1 heat duct. Wood basement walls were attached to cement with 4-5" lag bolts each end These bolts are visible. No stress or movement has yet showed. Wood walls sit on 18" wide by 8" deep footings. Cement floor is 2" above footings, holding walls secure. Base soil is heavy clay, undisturbed 4 1/2' below ground level. My special thanks to your firm for consultation on my do-it- myself wood basement. (149)

54. Re- electrical wiring- should be allowed to drill holes in studs near the top or bottom to facilitate easier stringing of wiring. Holes at these positions would not weaken the strength of the wall at those points. At least I don't think it would. (2)

55. My experience is that the cost is greater because of the crushed gravel and backfill sand required. Initially thought it would be cheaper. (12)

56. The wood floor has settled at the exterior walls- Maybe it would have been better with a floating cement floor. (13)

57. We have been very pleased with our wood basement. We have built 4 houses with wood foundations and would definitely build it again. (19)

58. Initial cost was higher for wood basement over cement. However ease of construction and ability to finish exterior walls as well as 'R' value, make wooden basements far superior, without question. (23)

59. What was great when we built, it rained constantly and people building concrete basements were haulted and we were able to continue which was a large plus. (25)

60. We have not lived in this house that long to know how it will last, but my opinion is that if your basement is built on higher ground and is well drained, I don't see why it won't last as long as cement. (29)

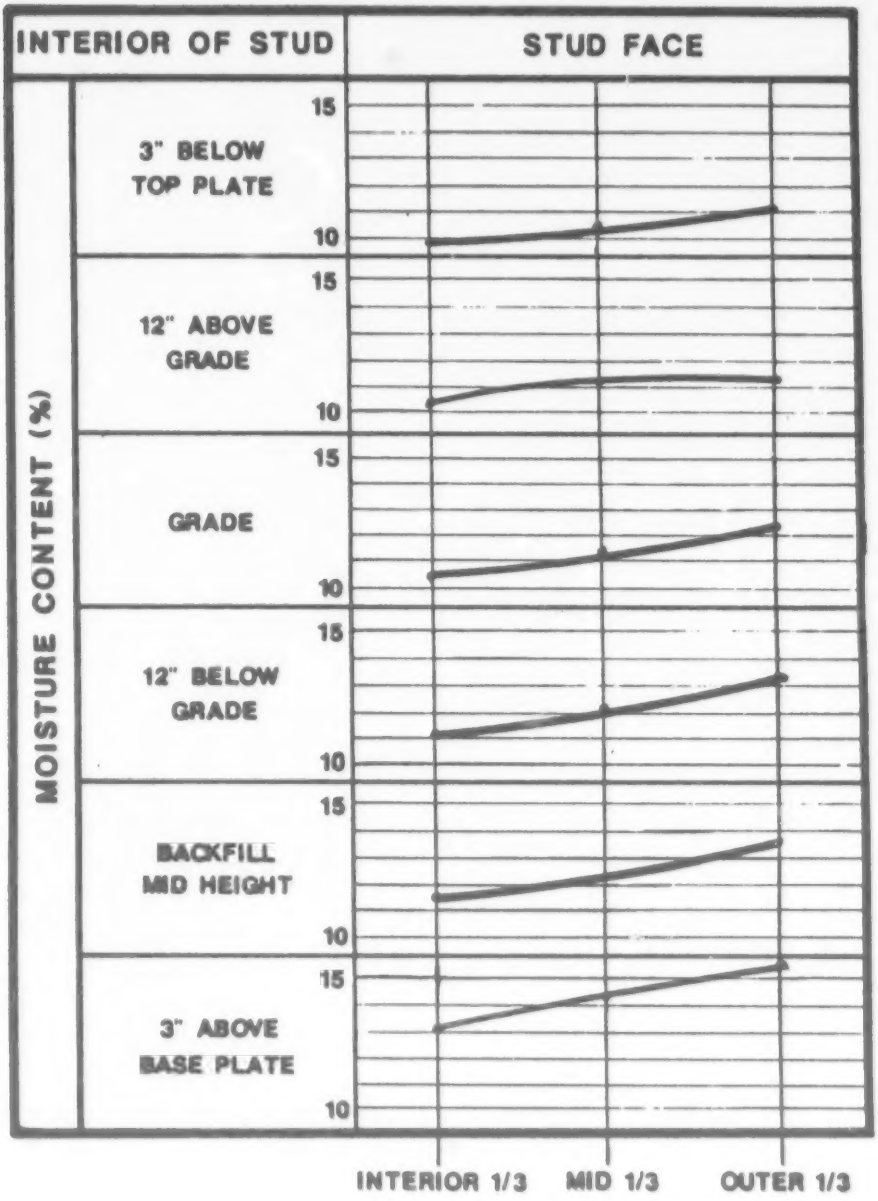
## Appendix D Wood Samples

### Part I Moisture Profiles Perpendicular to the Grain.

This Part I contains plots of the moisture contents of the three samples taken at each test location. These samples were obtained from the inner, centre and outer one-thirds of the stud. The plot on page D2 contains averages of all the samples, the plot on page D3 contains averages of the samples obtained where the enterior drainage is positive and away from the wall of the house and the plot on page D4 contains averages of the samples obtained where the enterior drainage is negative.

## PWF STUD MOISTURE PROFILE

### COMBINED DRAINAGE

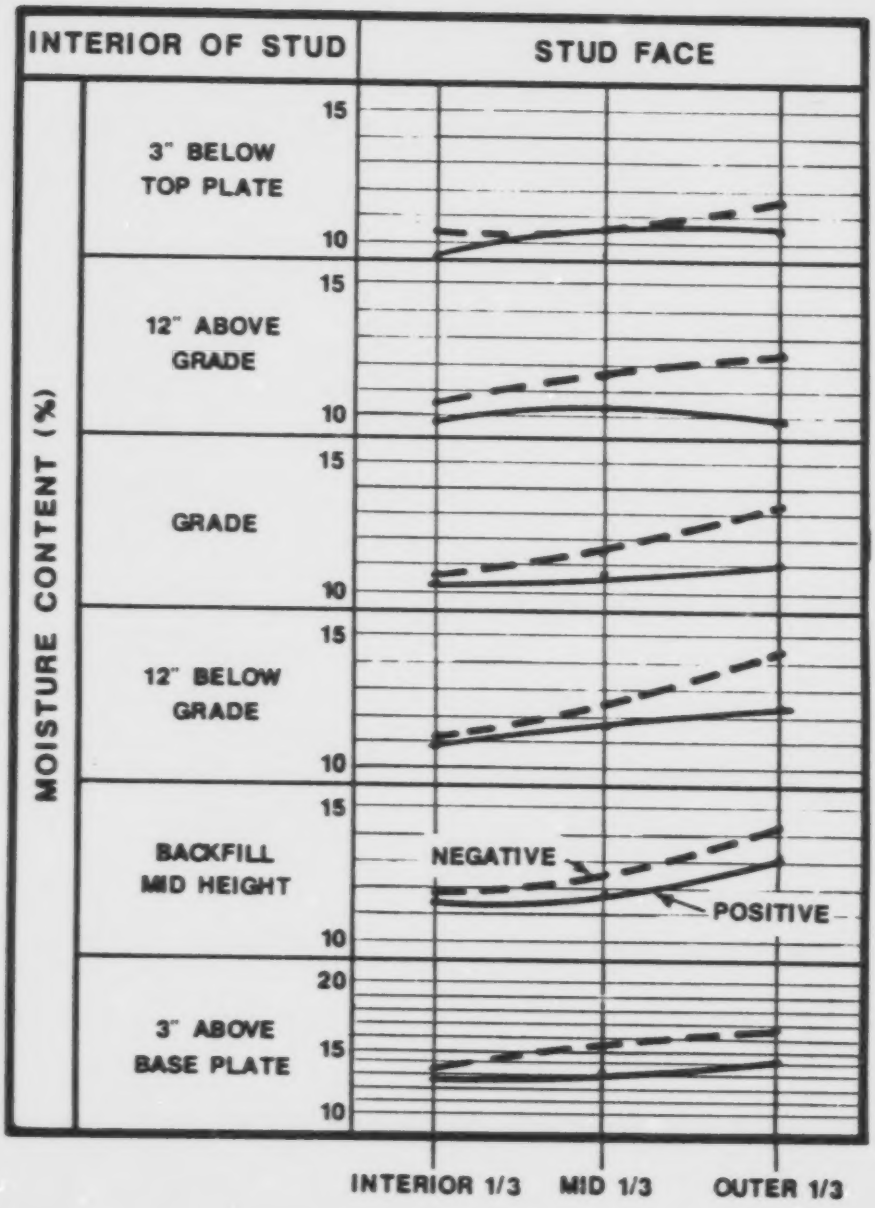



Moisture profiles across face of studs

TOTAL NUMBER OF SAMPLES -782

## PWF STUD MOISTURE PROFILE

### POSITIVE AND NEGATIVE DRAINAGE




**Moisture profiles across face of studs**

TOTAL NUMBER OF SAMPLES = 782

## MOISTURE PROFILE ACROSS FACE OF PWF STUDS

POSITIVE DRAINAGE

| SAMPLE LOCATION | MOISTURE CONTENT (%) | | |
|---|---|---|---|
| | INNER 1/3 | MIDDLE 1/3 | OUTER 1/3 |
| 3" BELOW TOP PLATE | 9.68 | 10.50 | 10.46 |
| 12" ABOVE GRADE | 9.93 | 10.20 | 9.98 |
| GRADE | 10.21 | 10.87 | 11.00 |
| 12" BELOW GRADE | 10.96 | 11.70 | 12.38 |
| BACKFILL MID HEIGHT | 11.49 | 11.94 | 13.09 |
| 3" ABOVE BASE PLATE | 12.73 | 13.09 | 14.31 |

TOTAL NUMBER OF SAMPLES = 351

## MOISTURE PROFILE ACROSS FACE OF PWF STUDS

NEGATIVE DRAINAGE

| SAMPLE LOCATION | MOISTURE CONTENT (%) | | |
|---|---|---|---|
| | INNER 1/3 | MIDDLE 1/3 | OUTER 1/3 |
| 3" BELOW TOP PLATE | 10.33 | 10.55 | 11.57 |
| 12" ABOVE GRADE | 10.68 | 11.82 | 12.25 |
| GRADE | 10.56 | 11.57 | 13.25 |
| 12" BELOW GRADE | 11.09 | 12.55 | 14.43 |
| BACKFILL MID HEIGHT | 11.81 | 12.60 | 14.19 |
| 3" ABOVE BASE PLATE | 13.38 | 15.20 | 16.89 |

TOTAL NUMBER OF SAMPLES = 431

## MOISTURE PROFILE ACROSS FACE OF PWF STUDS

COMBINED DRAINAGE

| SAMPLE LOCATION | MOISTURE CONTENT (%) | | |
|---|---|---|---|
| | INNER 1/3 | MIDDLE 1/3 | OUTER 1/3 |
| 3" BELOW TOP PLATE | 9.99 | 10.52 | 11.03 |
| 12" ABOVE GRADE | 10.35 | 11.11 | 11.26 |
| GRADE | 10.40 | 11.24 | 12.20 |
| 12" BELOW GRADE | 11.03 | 12.19 | 13.43 |
| BACKFILL MID HEIGHT | 11.68 | 12.32 | 13.73 |
| 3" ABOVE BASE PLATE | 13.09 | 14.25 | 15.73 |

TOTAL NUMBER OF SAMPLES = 782

## Appendix D Wood Samples

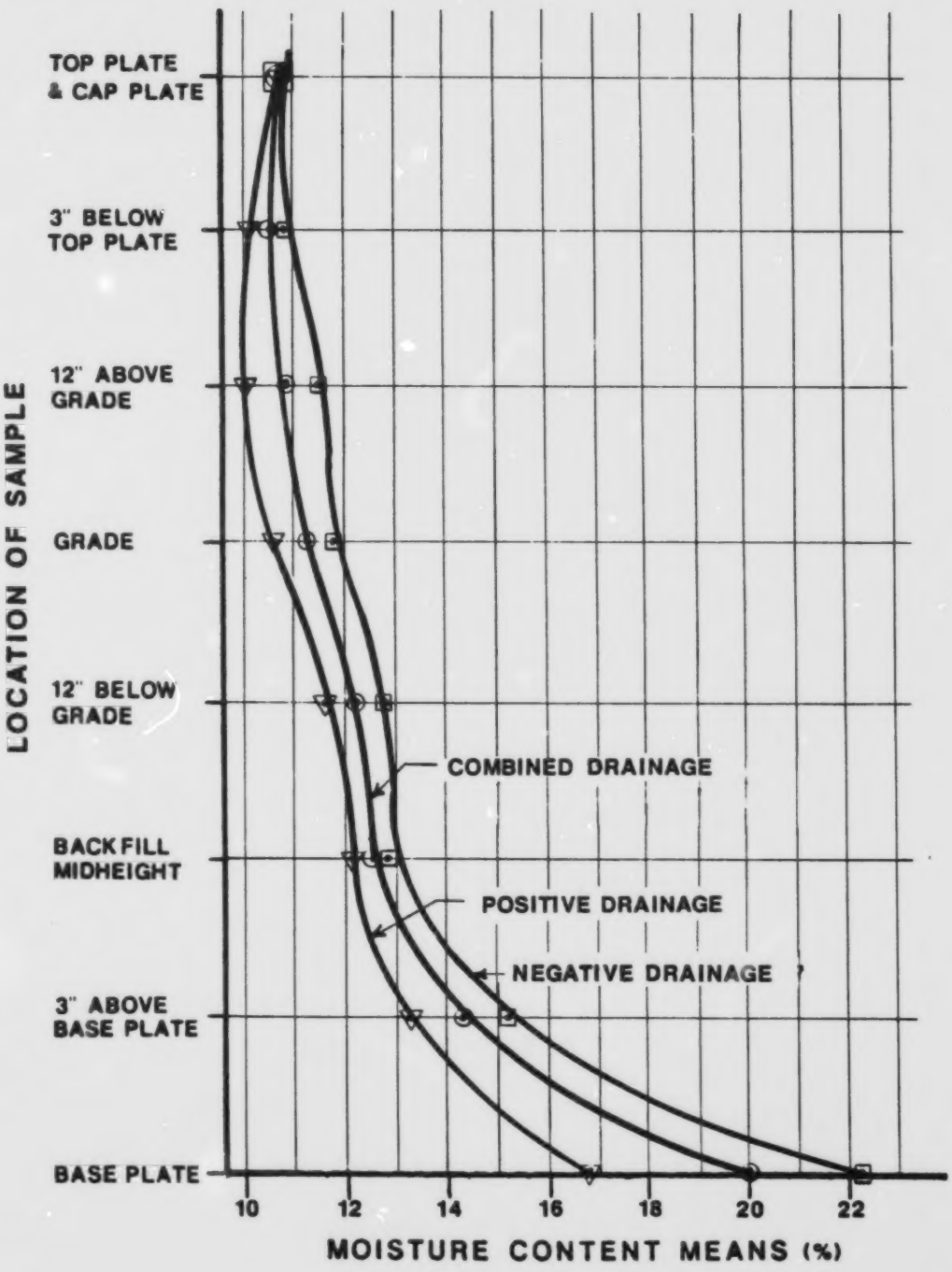
### Part II Moisture Content by Sampling Location

The graphs and tables on pages D7 and D8 contain interpretations of the moisture contents of the PWF studs. The plot on page D7 shows the moisture profile for positive, negative and combined drainage. The table on the top of page D8 contains the value of the mean moisture content at the specified testing location for Positive, Negative and Combined Drainage. The table at the bottom of page D8 gives the average of all the moisture contents of the PWF studs.

# LOCATION
VS
# MOISTURE CONTENT

POSITIVE DRAINAGE, NEGATIVE DRAINAGE AND
COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 1011



## MOISTURE CONTENT MEAN COMPARISON
FOR THE PWF STUDS & THE BOTTOM PLATE

| SAMPLE LOCATION | POSITIVE DRAINAGE | NEGATIVE DRAINAGE | COMBINED POSITIVE & NEGATIVE DRAINAGE |
|---|---|---|---|
| BASE PLATE | 16.82 | 22.18 | 20.08 |
| 3" ABOVE BASE PLATE | 13.37 | 15.18 | 14.37 |
| BACKFILL MID HEIGHT | 12.17 | 12.86 | 12.57 |
| 12" BELOW GRADE | 11.60 | 12.83 | 12.22 |
| GRADE | 10.69 | 11.79 | 11.28 |
| 12" ABOVE GRADE | 10.04 | 11.58 | 10.91 |
| 3" BELOW TOP PLATE | 10.20 | 10.81 | 10.52 |
| TOP PLATE & CAP PLATE | 10.76 | 10.84 | 10.73 |
| | | | |

TOTAL NUMBER OF SAMPLES = 907

## MOISTURE CONTENT AVERAGE OF ALL MEANS
FOR THE PWF STUDS

1. POSITIVE DRAINAGE = 11.26
2. NEGATIVE DRAINAGE = 12.27
3. COMBINED POSITIVE & NEGATIVE DRAINAGE = 11.80

## Appendix D Wood Samples

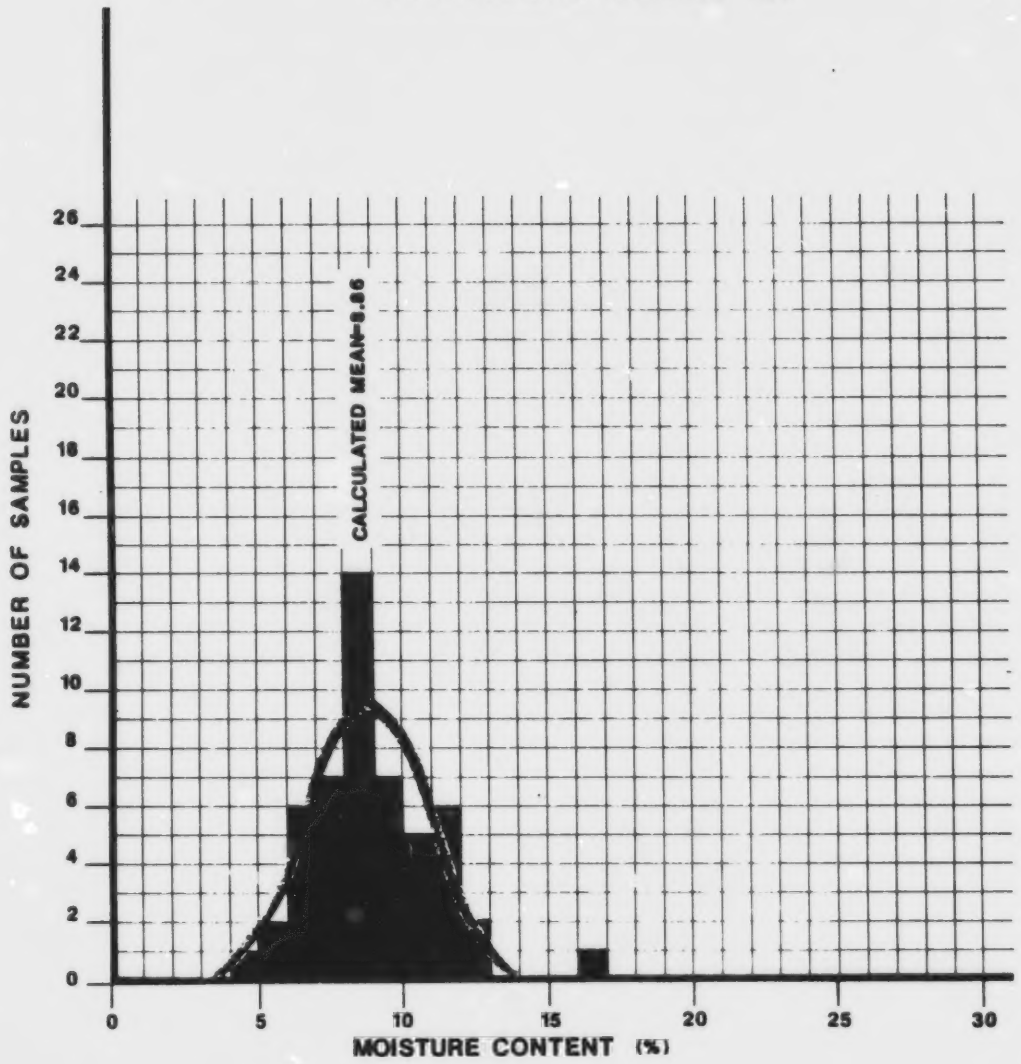
### Part III Moisture Contents with Combined Negative and Positive Drainage.

The plots on pages D10 to D20 are normal distribution plots of all of the moisture contents obtained, the calculated mean, and the best fit normal distribution curve.

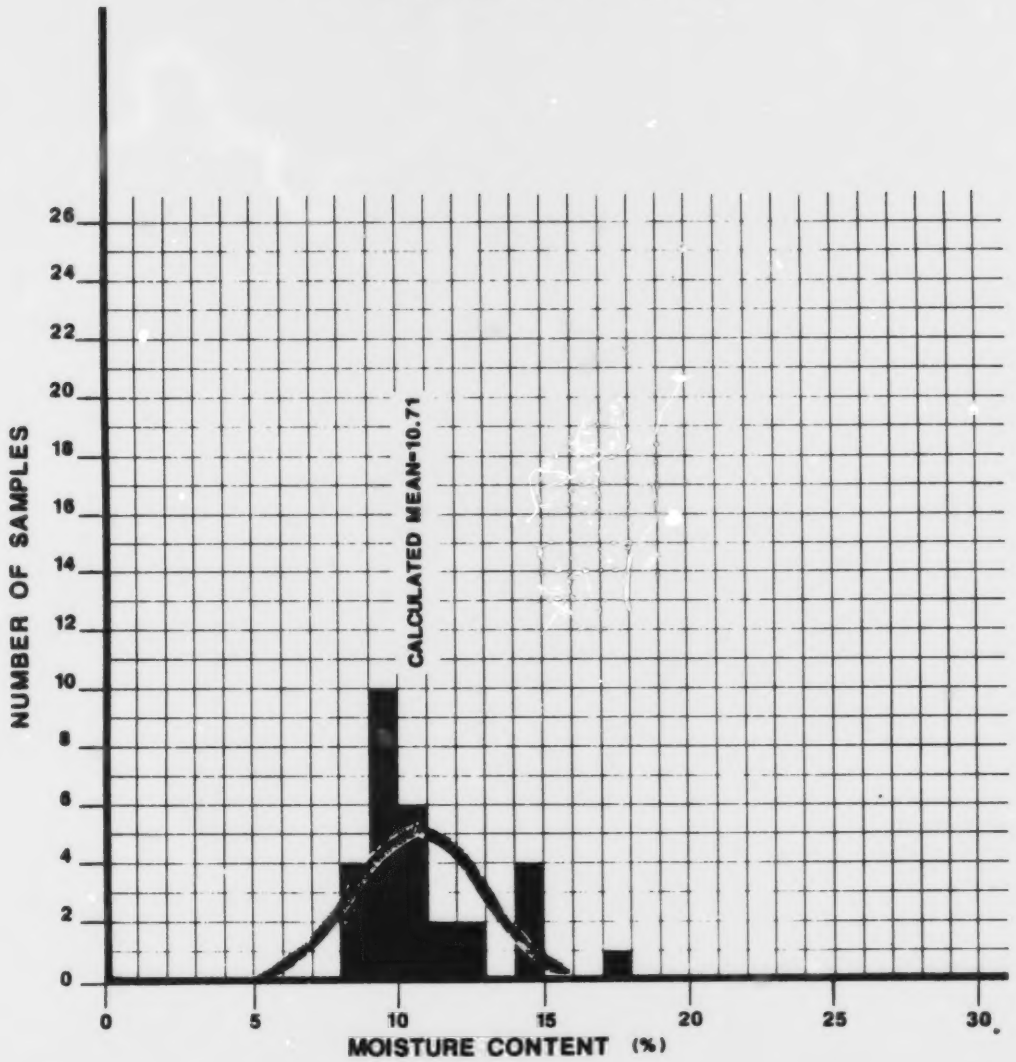
## FLOOR JOISTS

COMBINED DRAINAGE

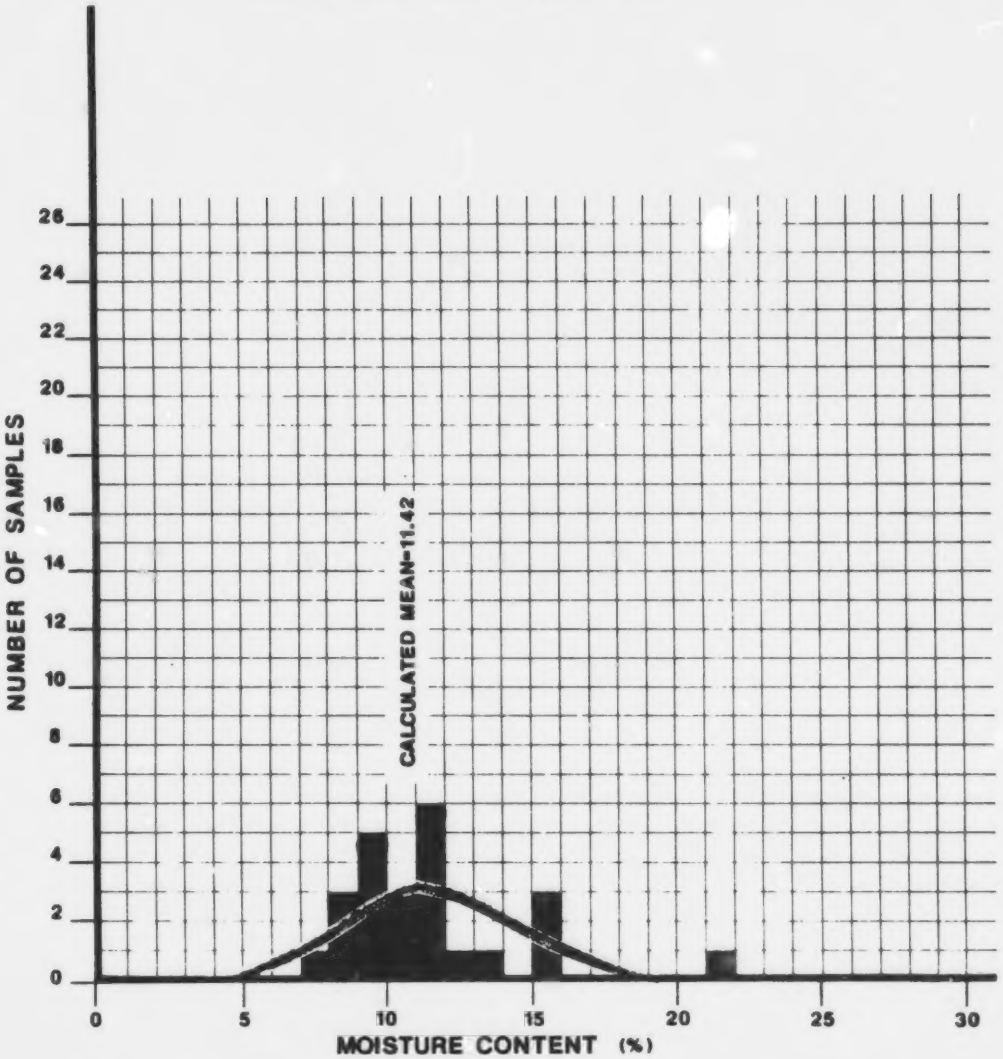
TOTAL NUMBER OF SAMPLES = 51



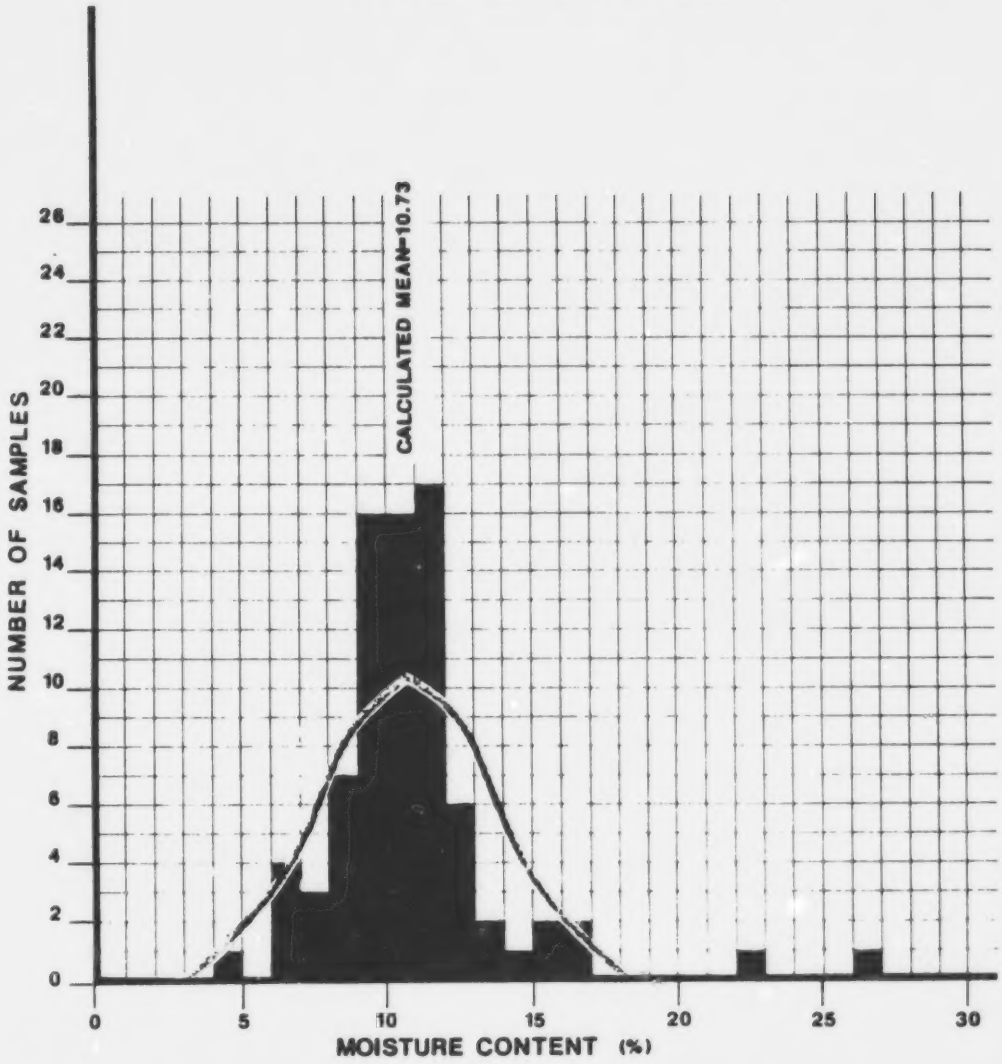
## INTERIOR STUD
## 3" ABOVE BASE PLATE
### COMBINED DRAINAGE
### TOTAL NUMBER OF SAMPLES = 29

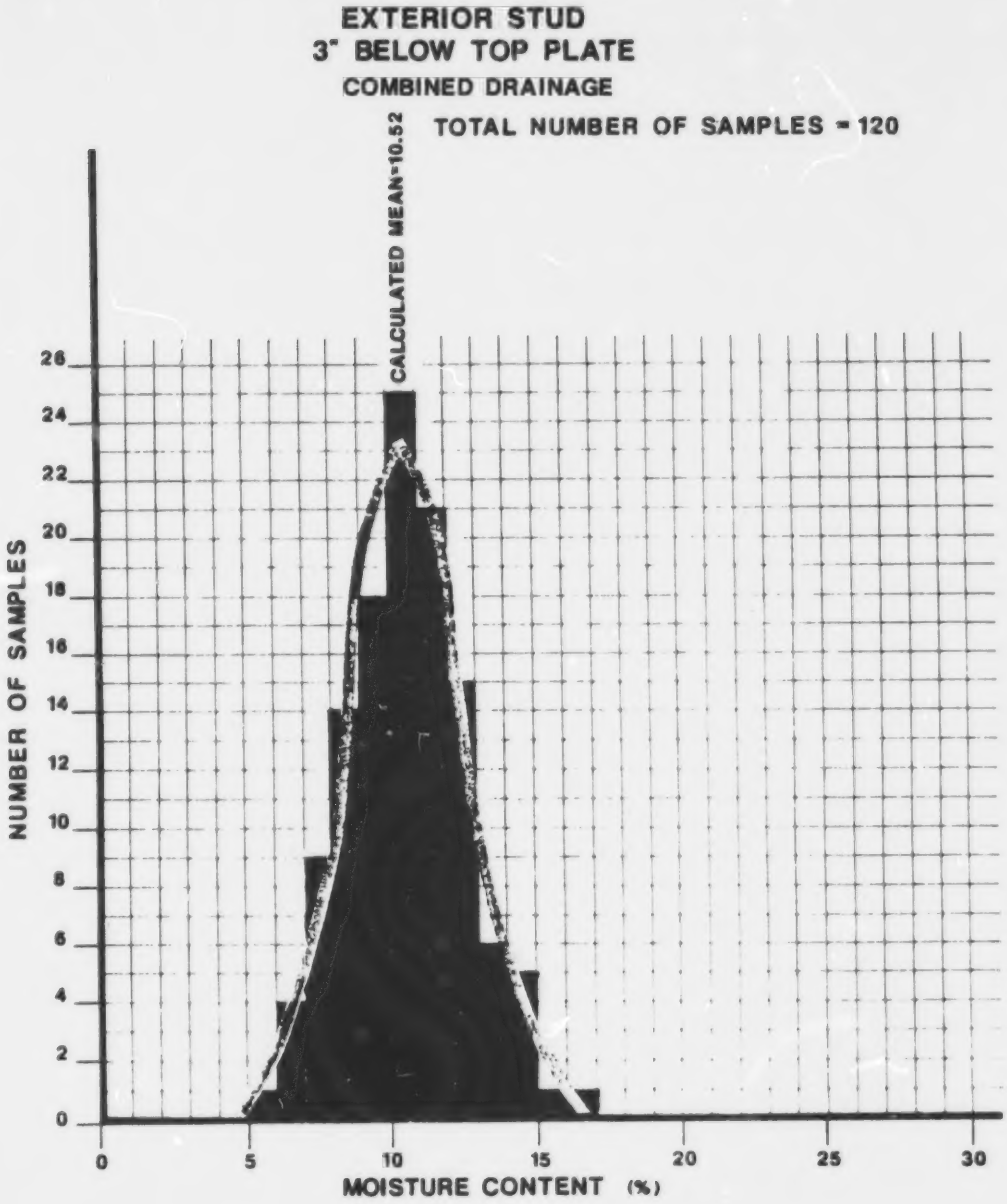


## INTERIOR STUD
## BASE PLATE
### COMBINED DRAINAGE
### TOTAL NUMBER OF SAMPLES = 24



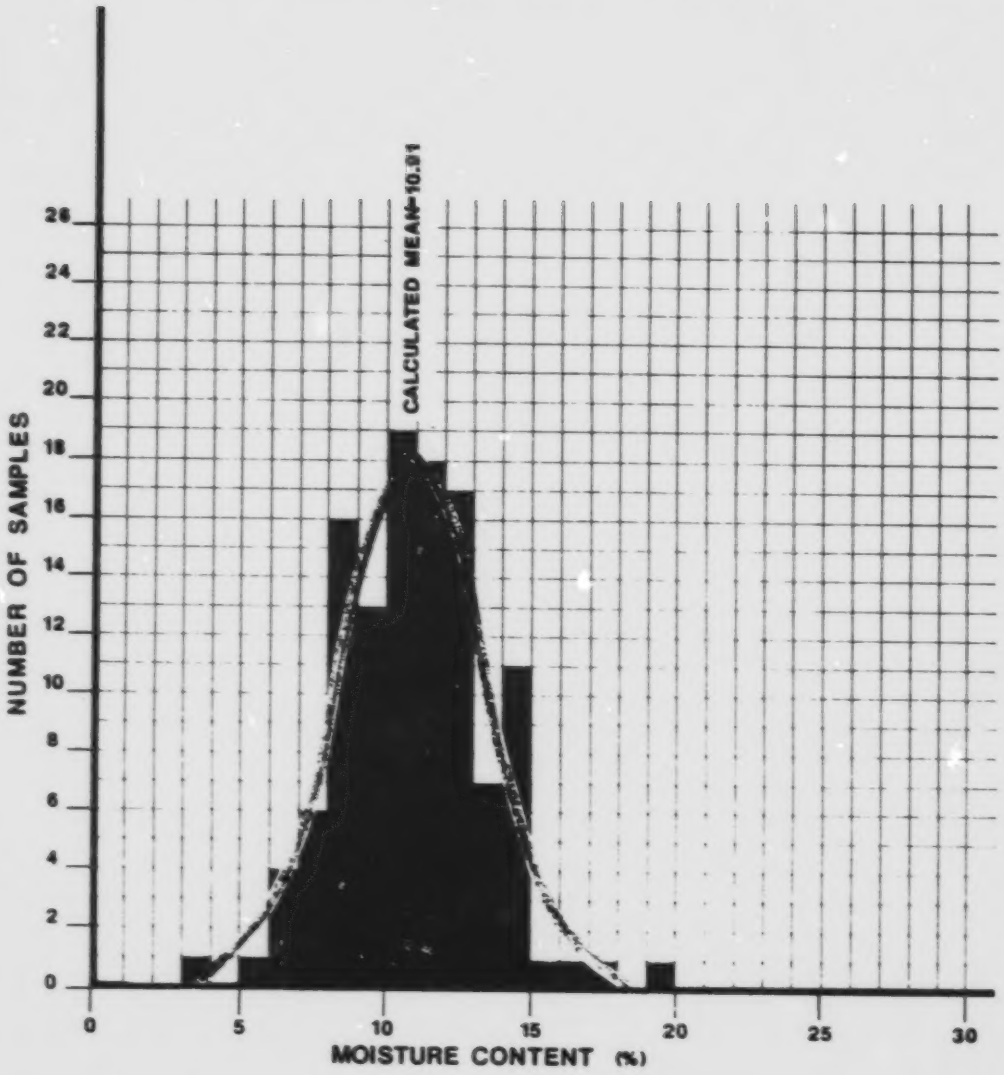
## EXTERIOR STUD
## TOP PLATE AND CAP PLATE
### COMBINED DRAINAGE
### TOTAL NUMBER OF SAMPLES = 79




EXTERIOR STUD
3" BELOW TOP PLATE
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES = 120
CALCULATED MEAN=10.52
NUMBER OF SAMPLES
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
5
10
15
20
25
30
MOISTURE CONTENT (%)

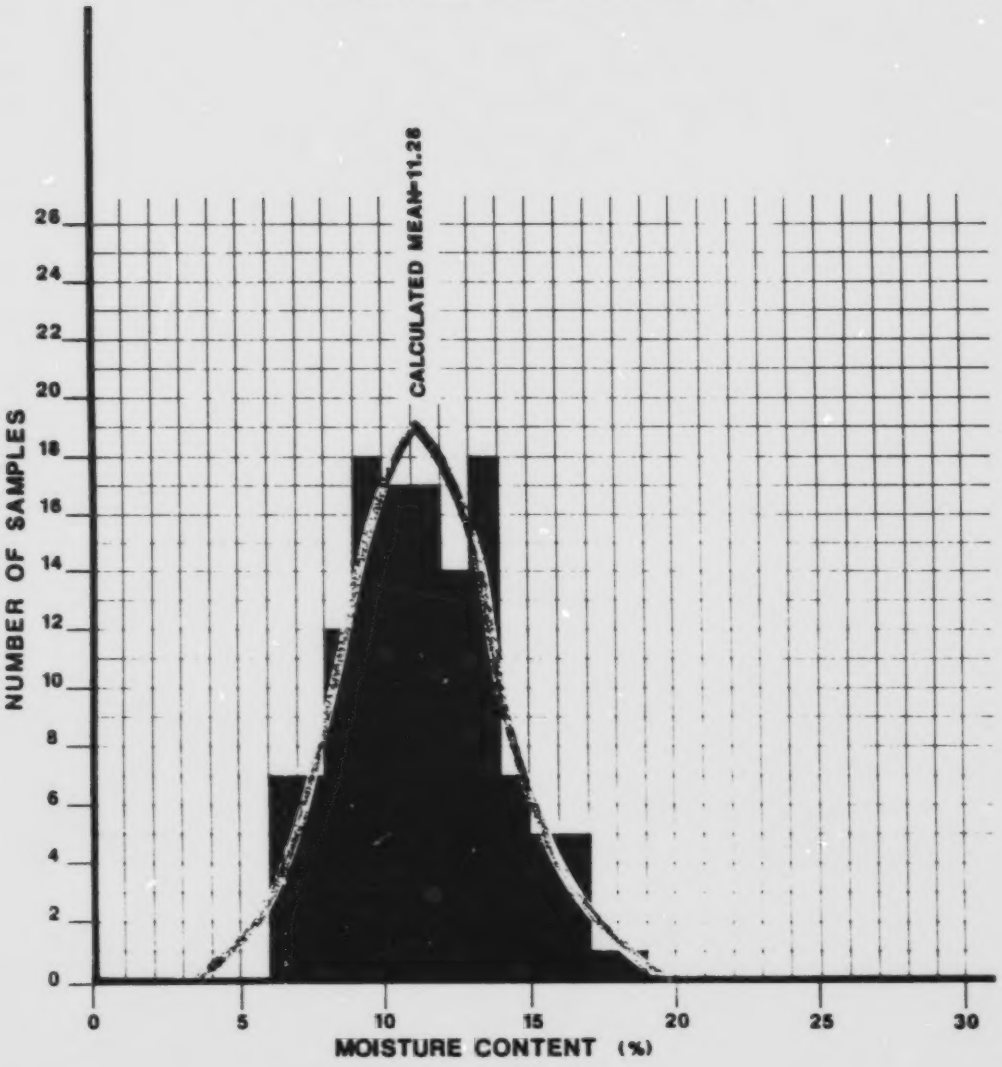
## EXTERIOR STUD
## 12" ABOVE GRADE
### COMBINED DRAINAGE

TOTAL NUMBER OF SAMPLES = 117



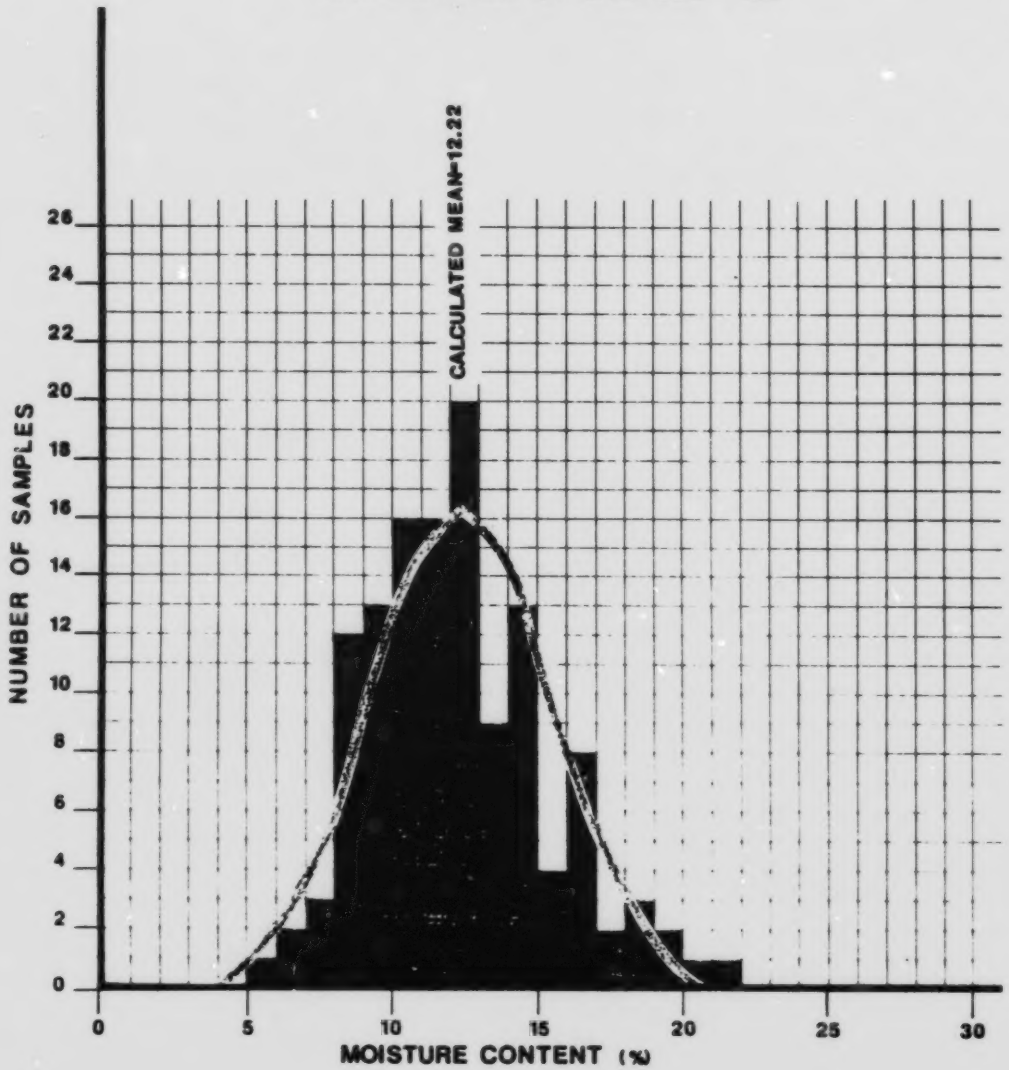
## EXTERIOR STUD
## TOP OF GRADE
### COMBINED DRAINAGE

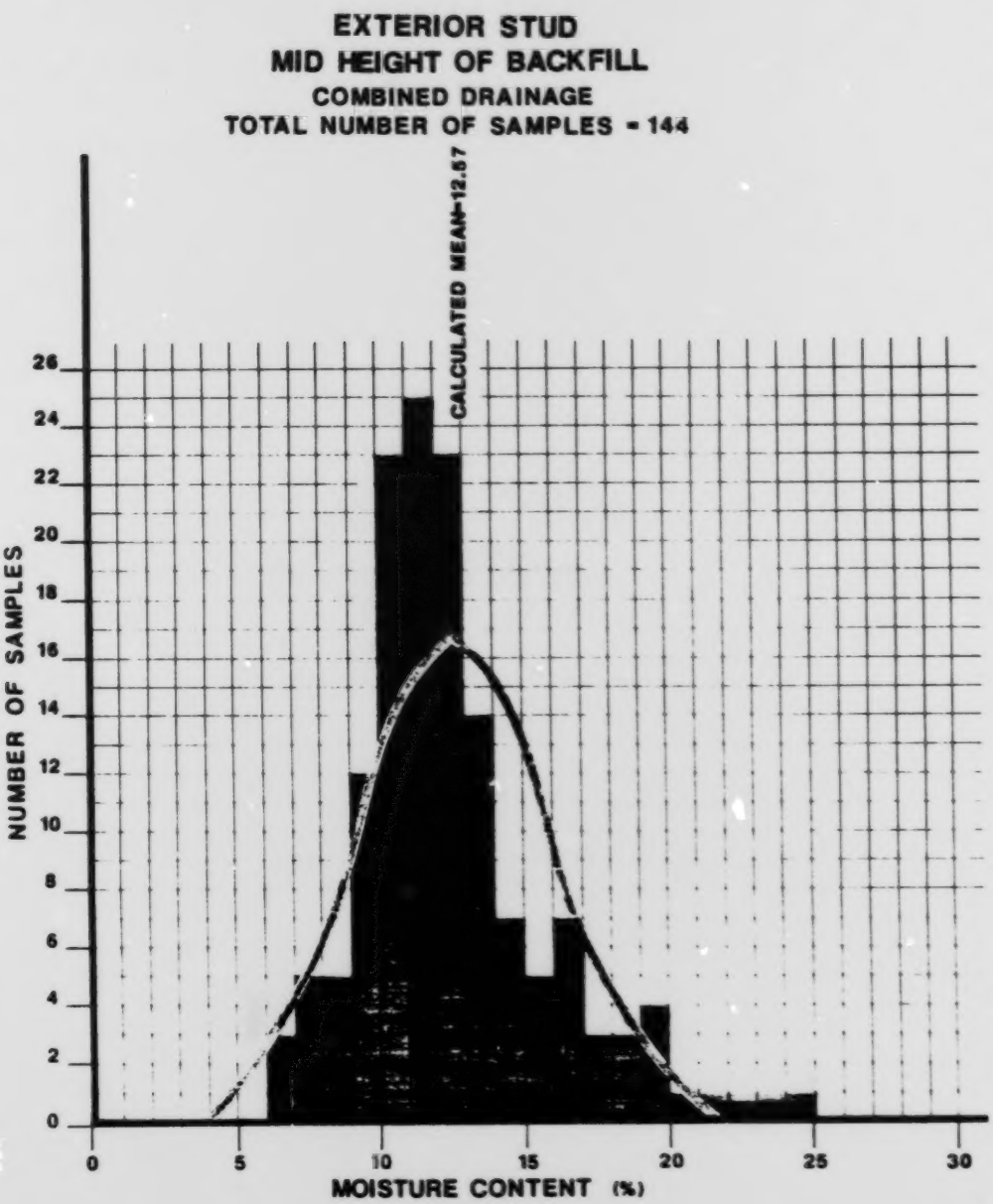
TOTAL NUMBER OF SAMPLES = 129



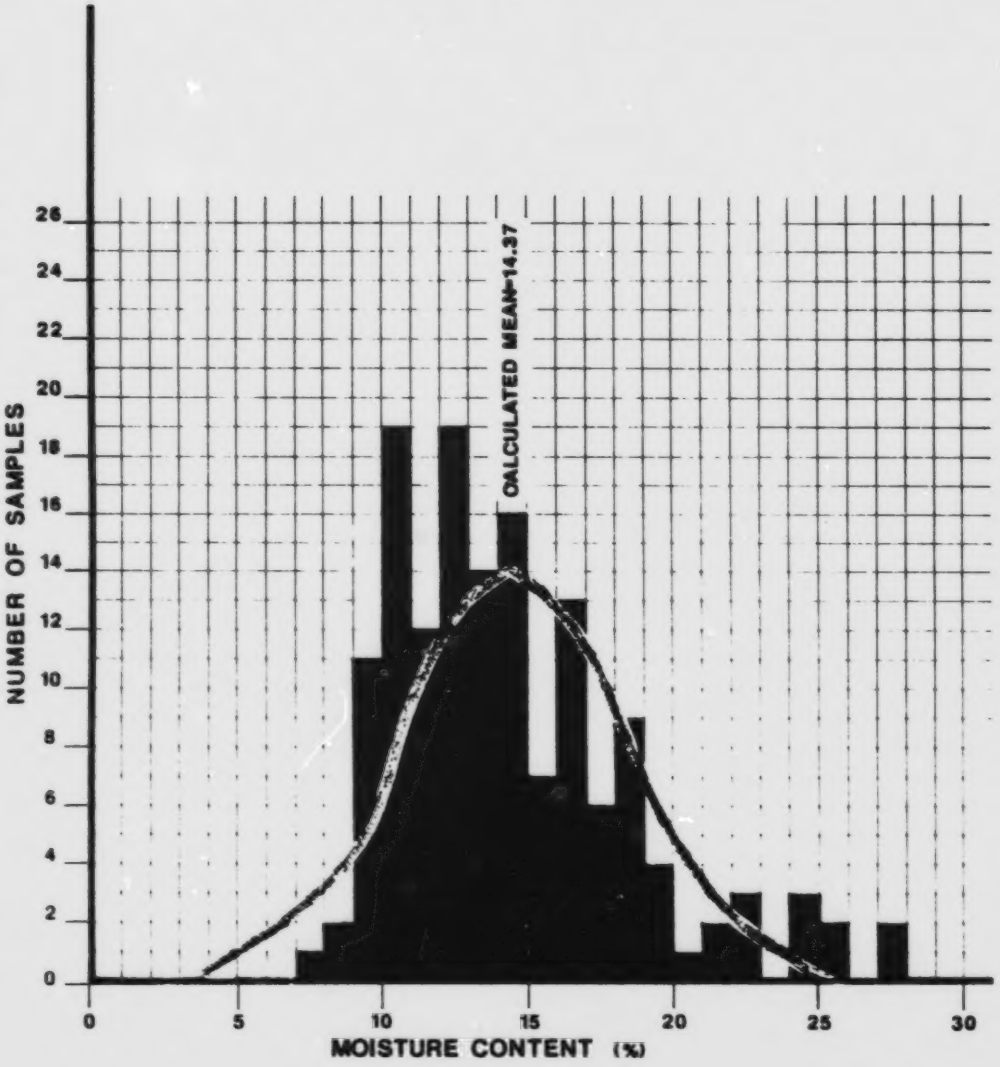
## EXTERIOR STUD
## 12" BELOW GRADE
### COMBINED DRAINAGE

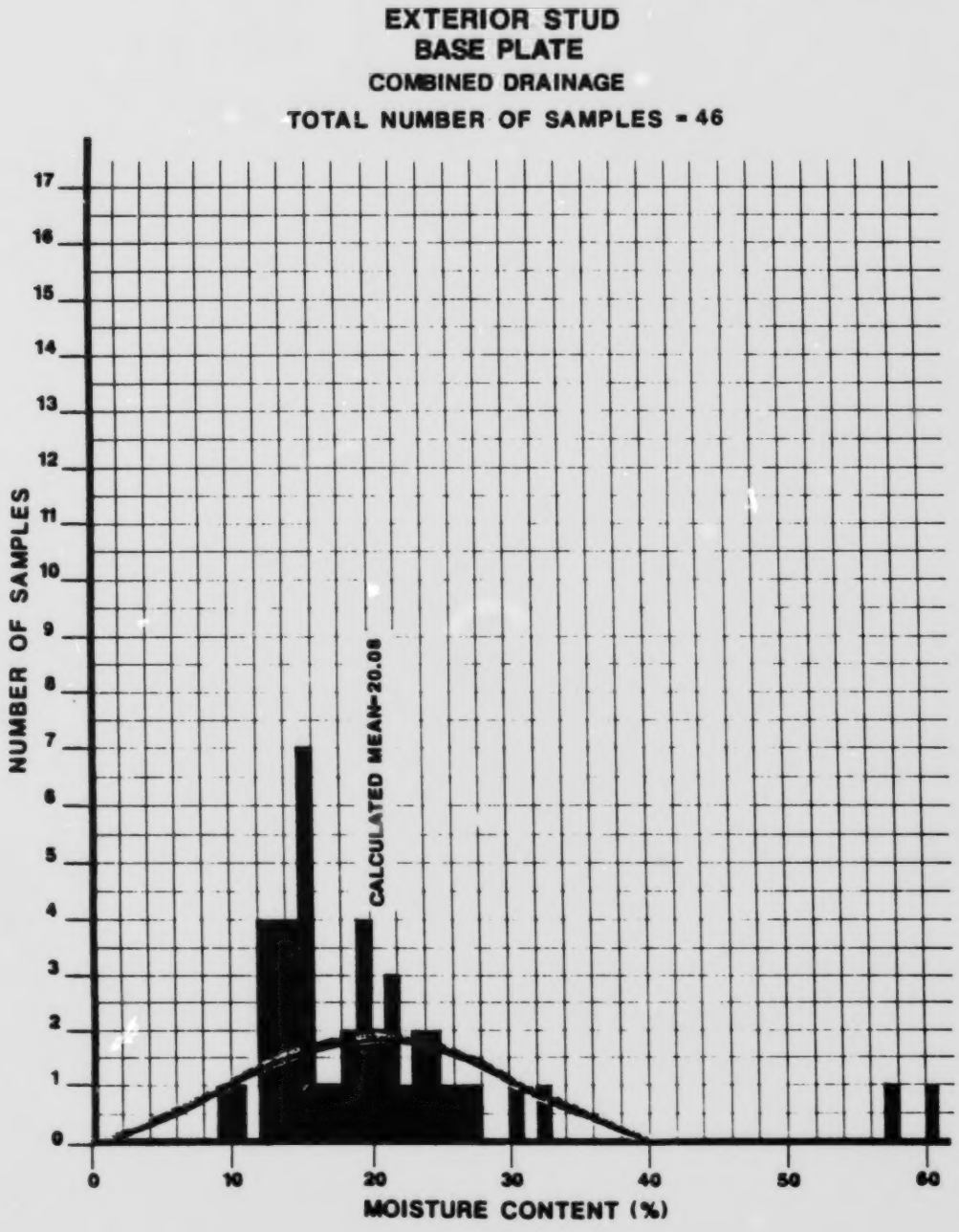
TOTAL NUMBER OF SAMPLES = 126




EXTERIOR STUD
MID HEIGHT OF BACKFILL
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES = 144
CALCULATED MEAN=12.67
NUMBER OF SAMPLES
0
2
4
6
8
10
12
14
16
18
20
22
24
26
0
5
10
15
20
25
30
MOISTURE CONTENT (%)

## EXTERIOR STUD
## 3" ABOVE BASE PLATE
### COMBINED DRAINAGE
### TOTAL NUMBER OF SAMPLES = 146




EXTERIOR STUD
BASE PLATE
COMBINED DRAINAGE
TOTAL NUMBER OF SAMPLES = 46
NUMBER OF SAMPLES
CALCULATED MEAN=20.08
MOISTURE CONTENT (%)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
0
10
20
30
40
50
60

## Appendix D Wood Samples

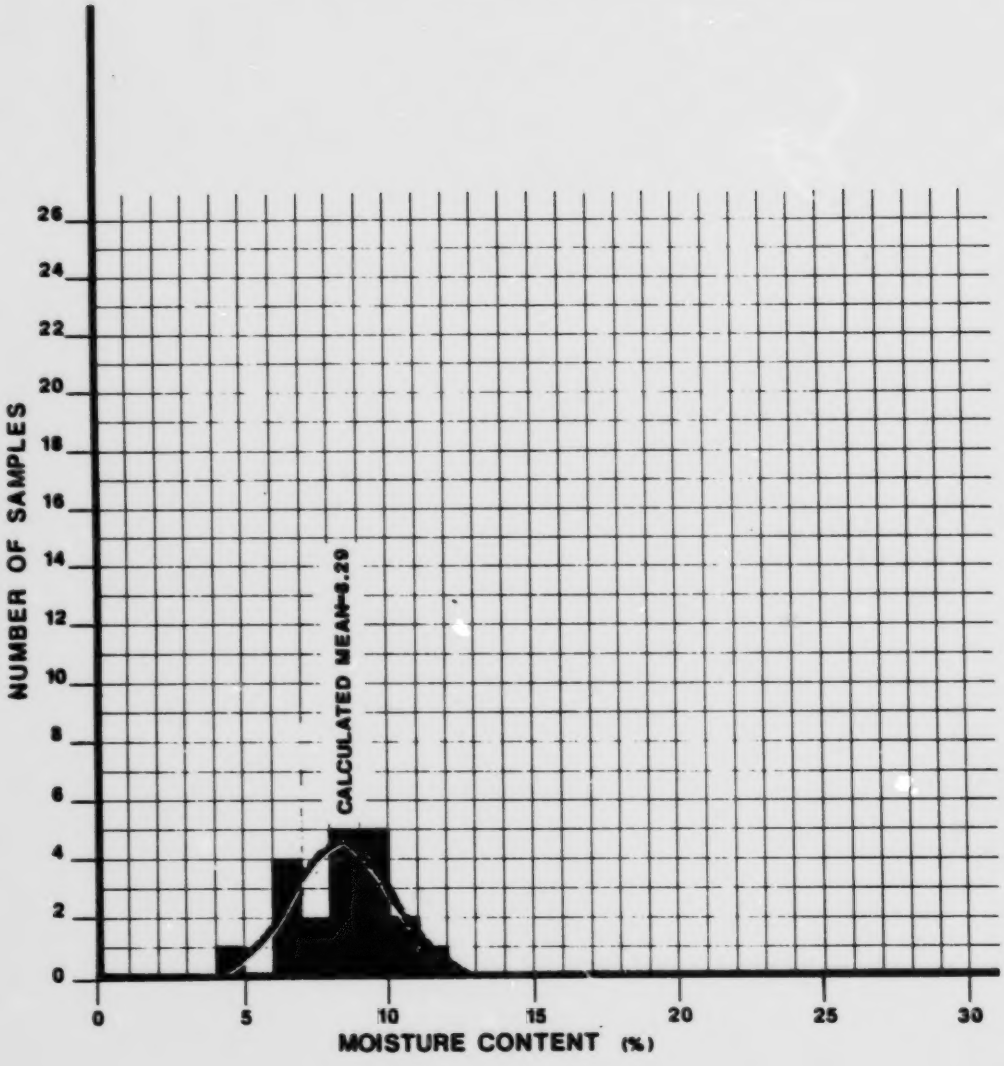
### Part IV Moisture Contents with Positive Backfill Drainage

The plots on pages D22 to D32 are normal distribution plots of the moisture contents taken where the exterior drainage is positive, the calculated mean and the best fit normal distribution curve.

## FLOOR JOISTS

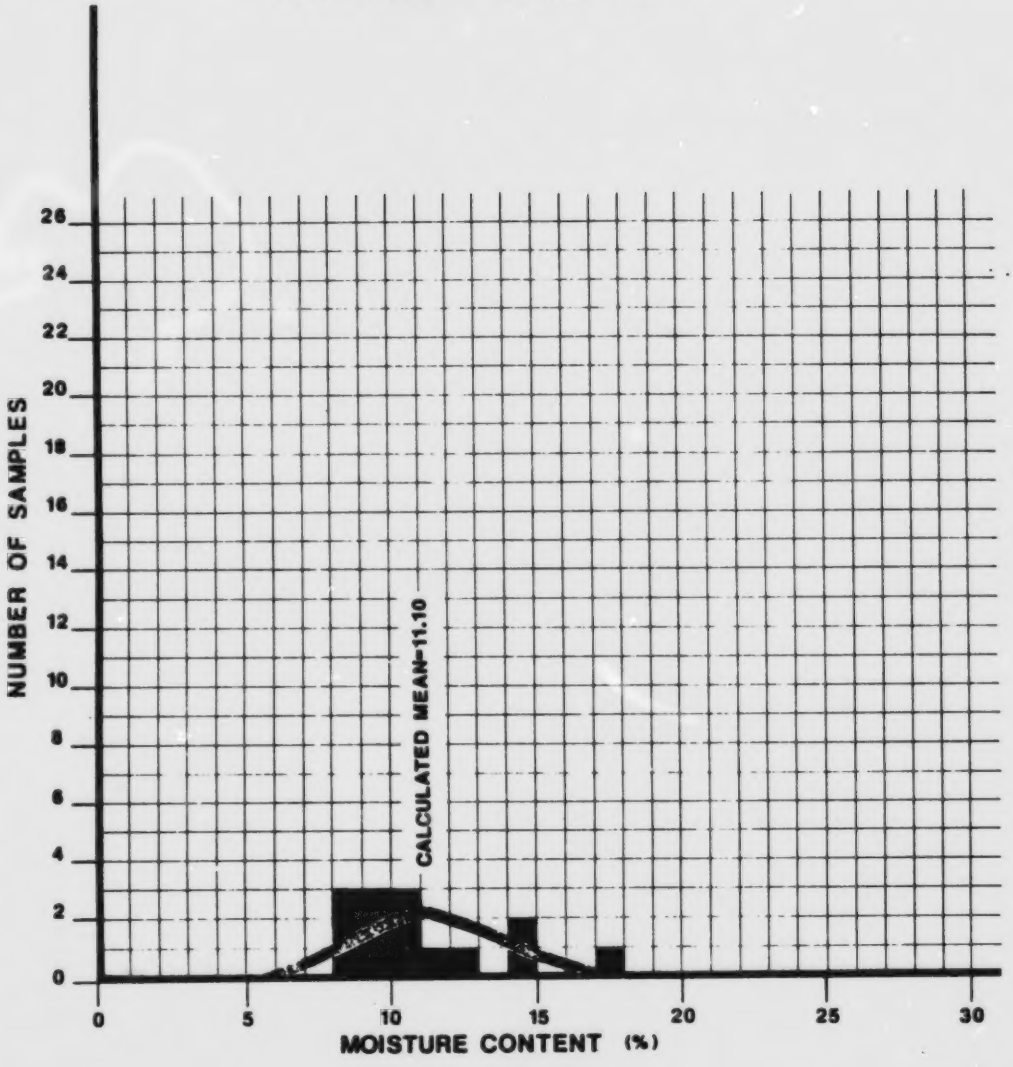
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 20



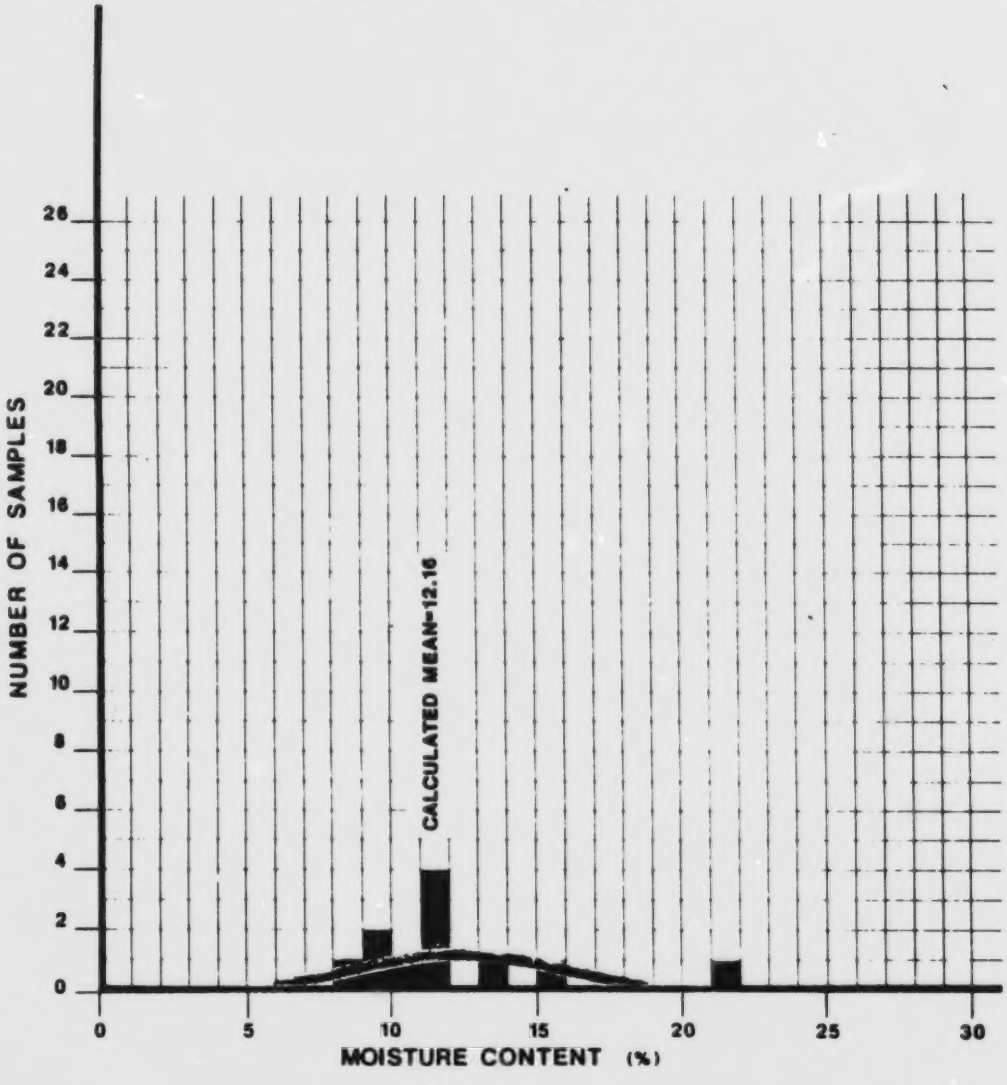
## INTERIOR STUD
## 3" ABOVE BASE PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 14



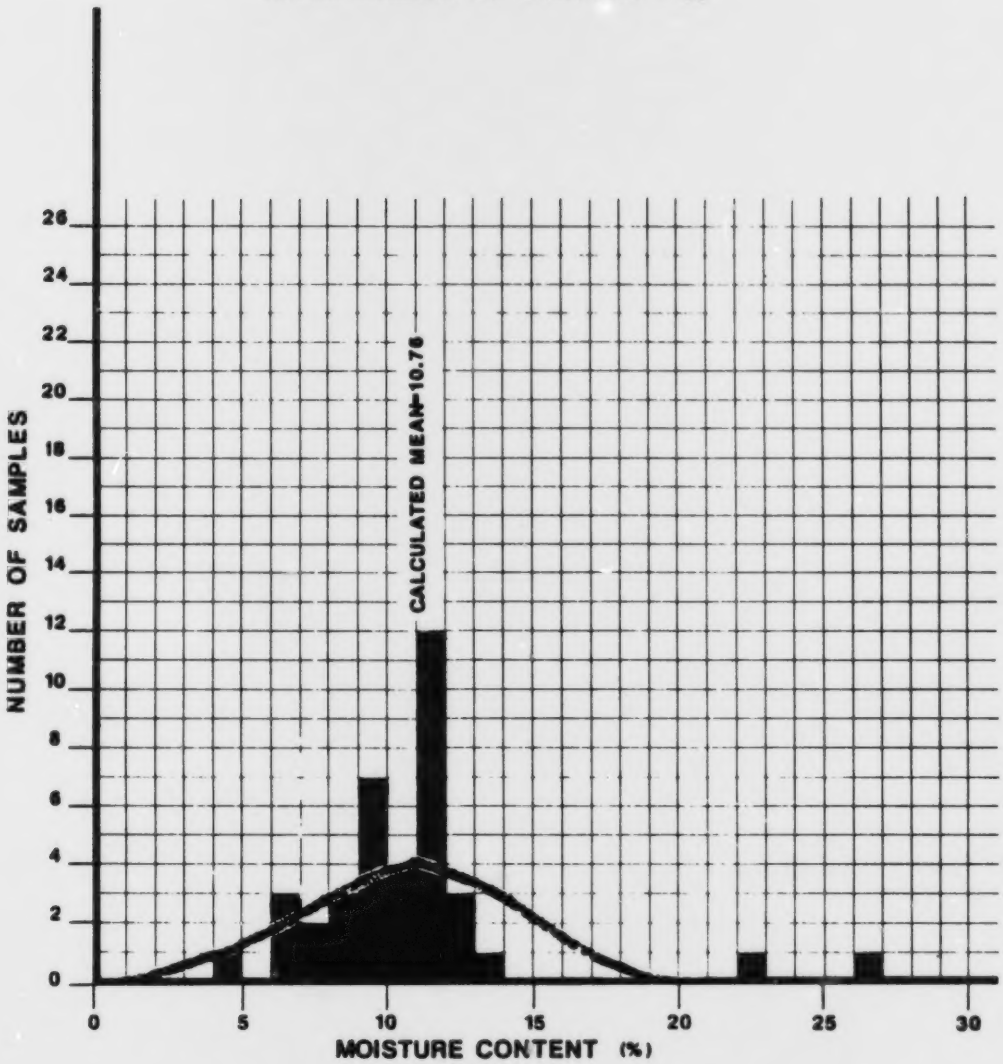
## INTERIOR STUD
## BASE PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 11



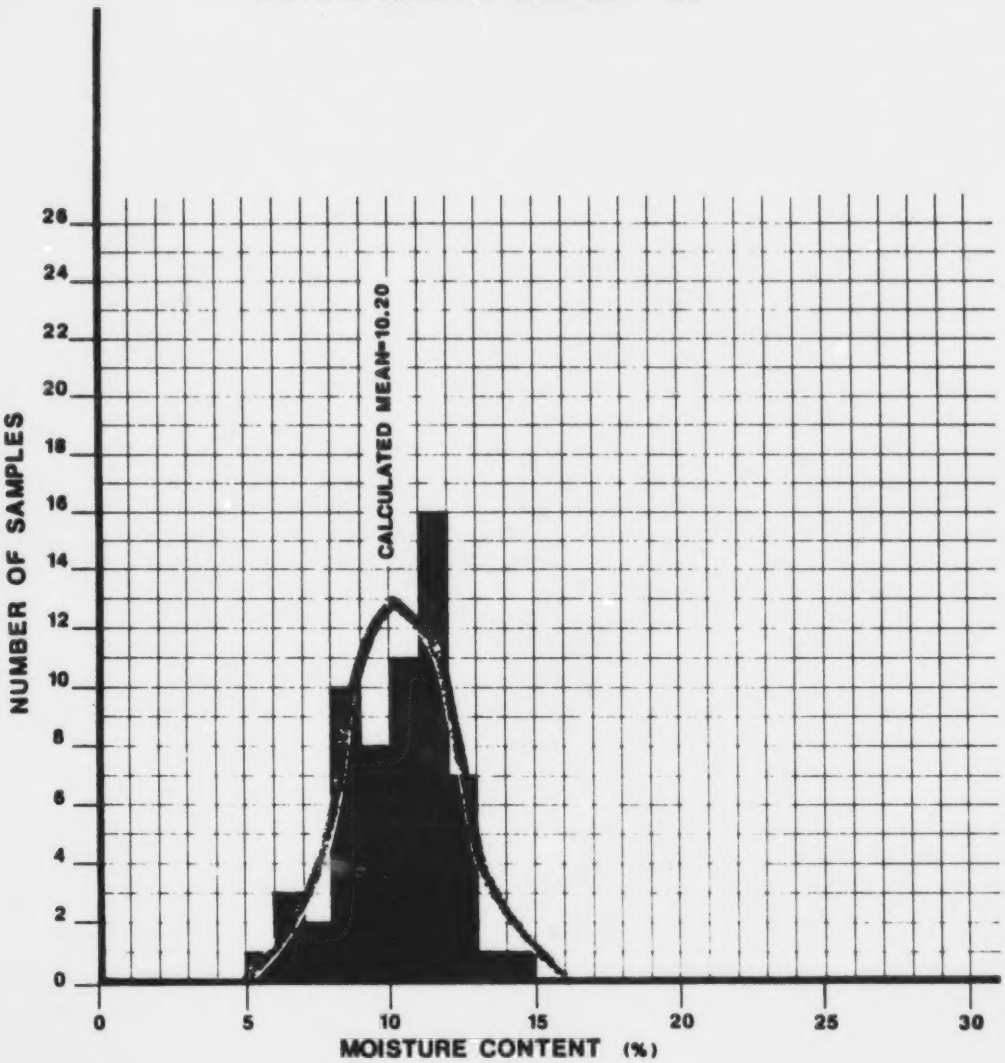
## EXTERIOR STUD
## TOP PLATE AND CAP PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 38



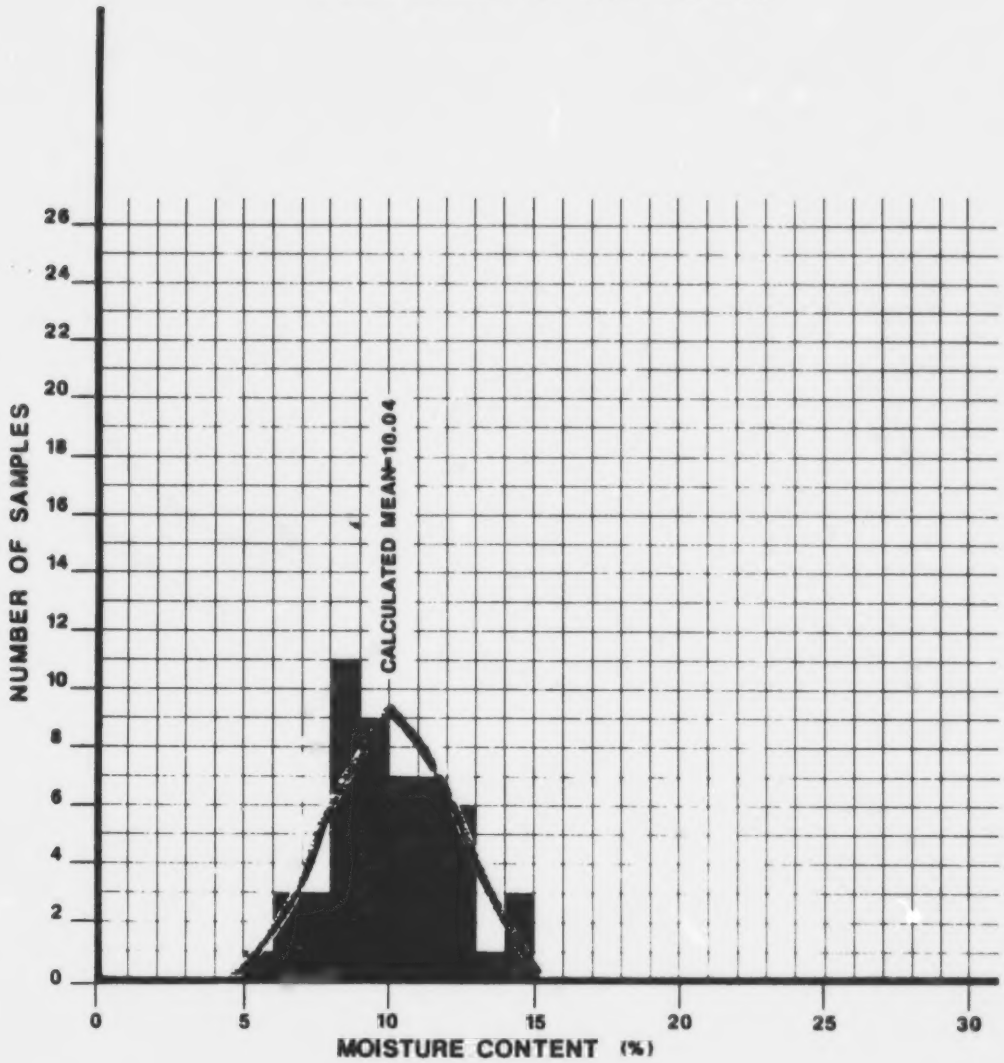
## EXTERIOR STUD
## 3" BELOW TOP PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



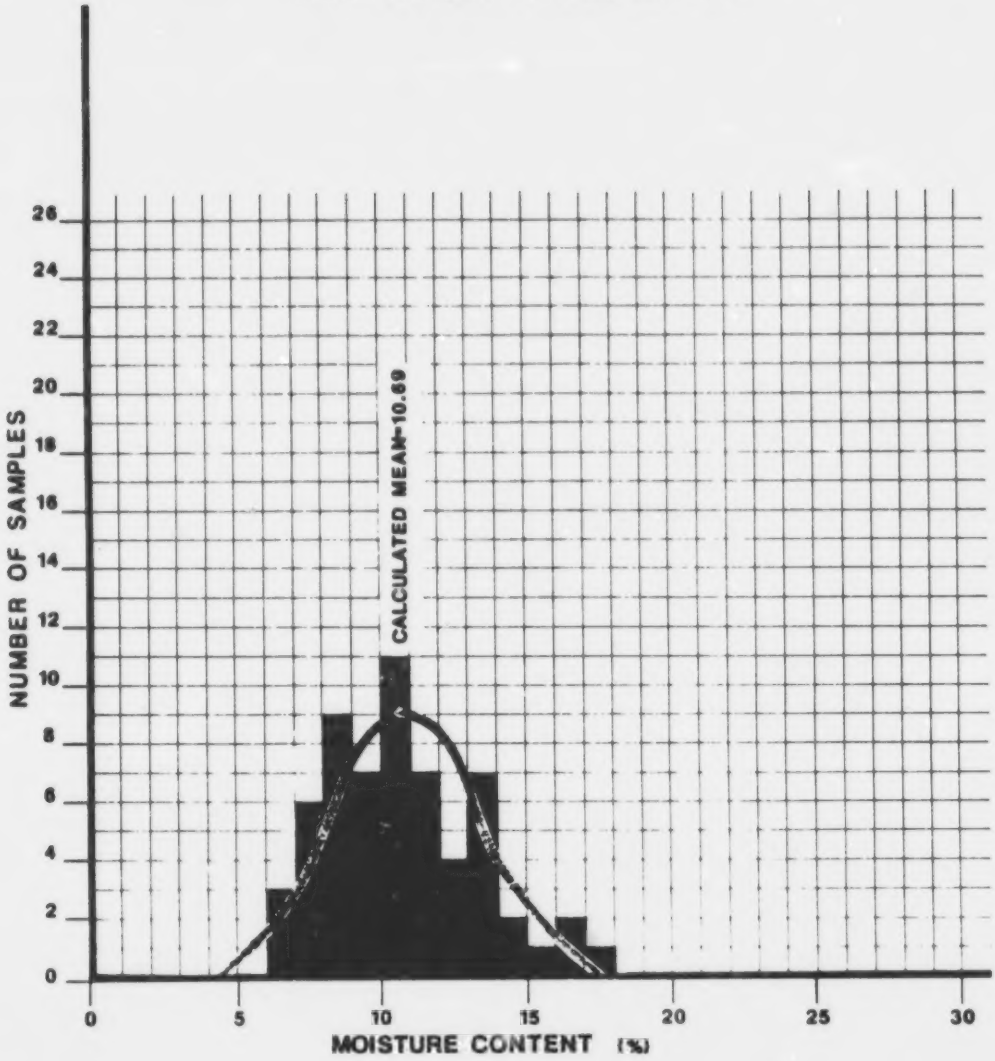
## EXTERIOR STUD
## 12" ABOVE GRADE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 51



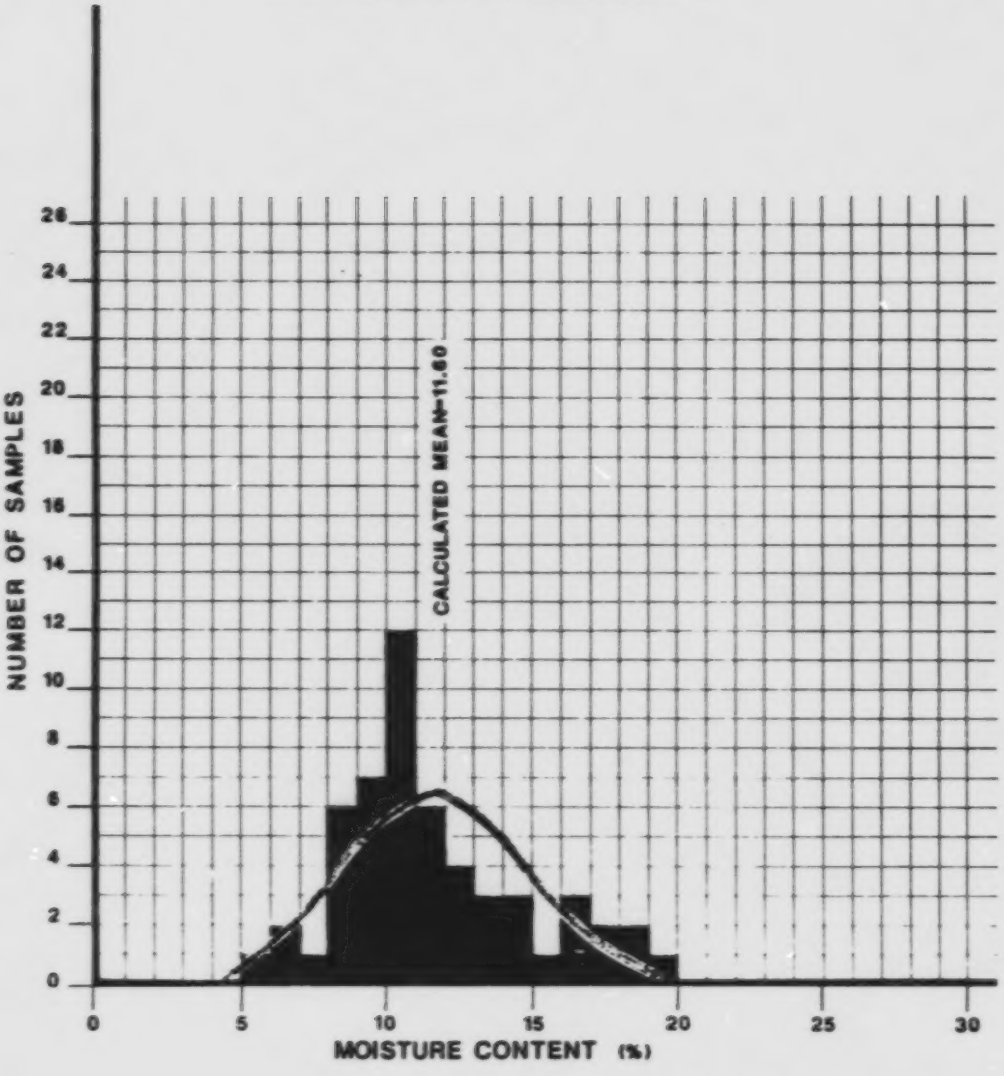
## EXTERIOR STUD
## TOP OF GRADE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



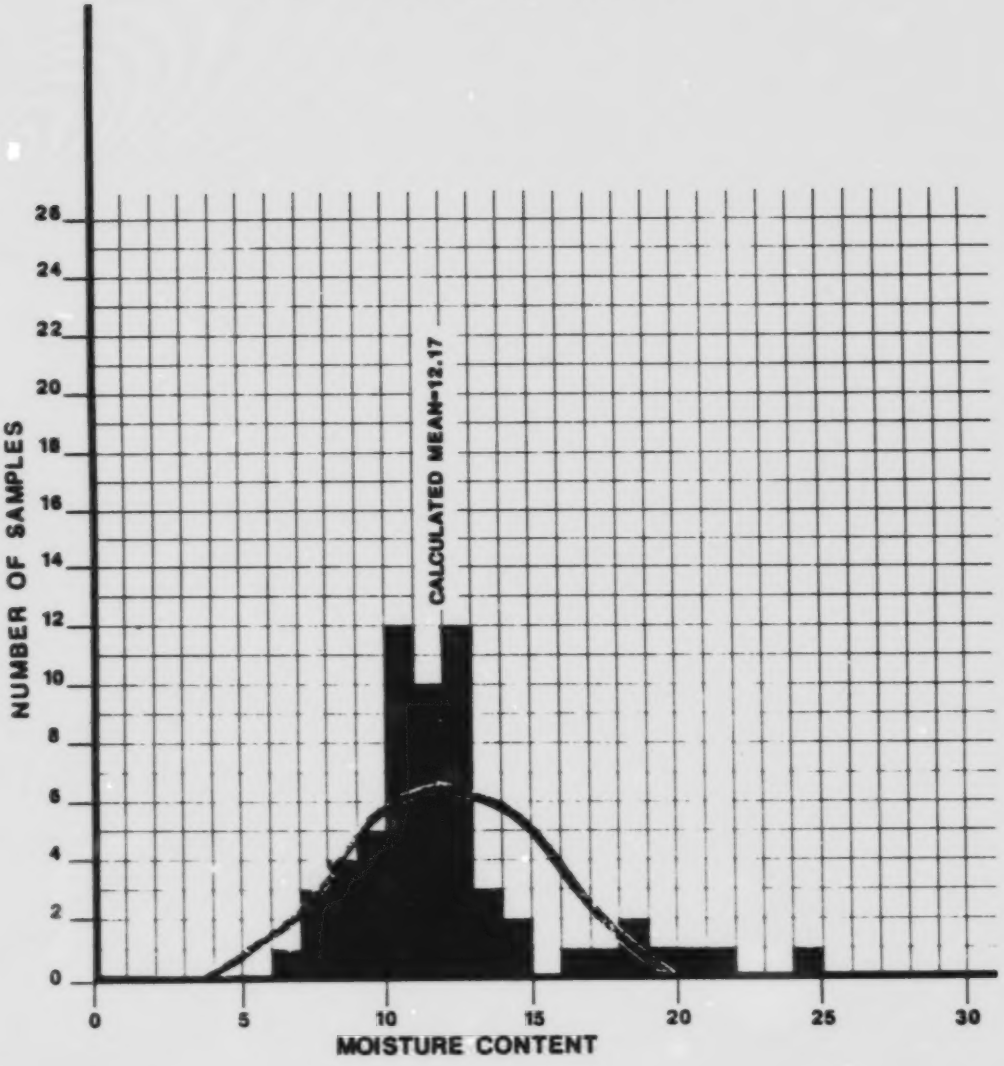
EXTERIOR STUD
12" BELOW GRADE
POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 54



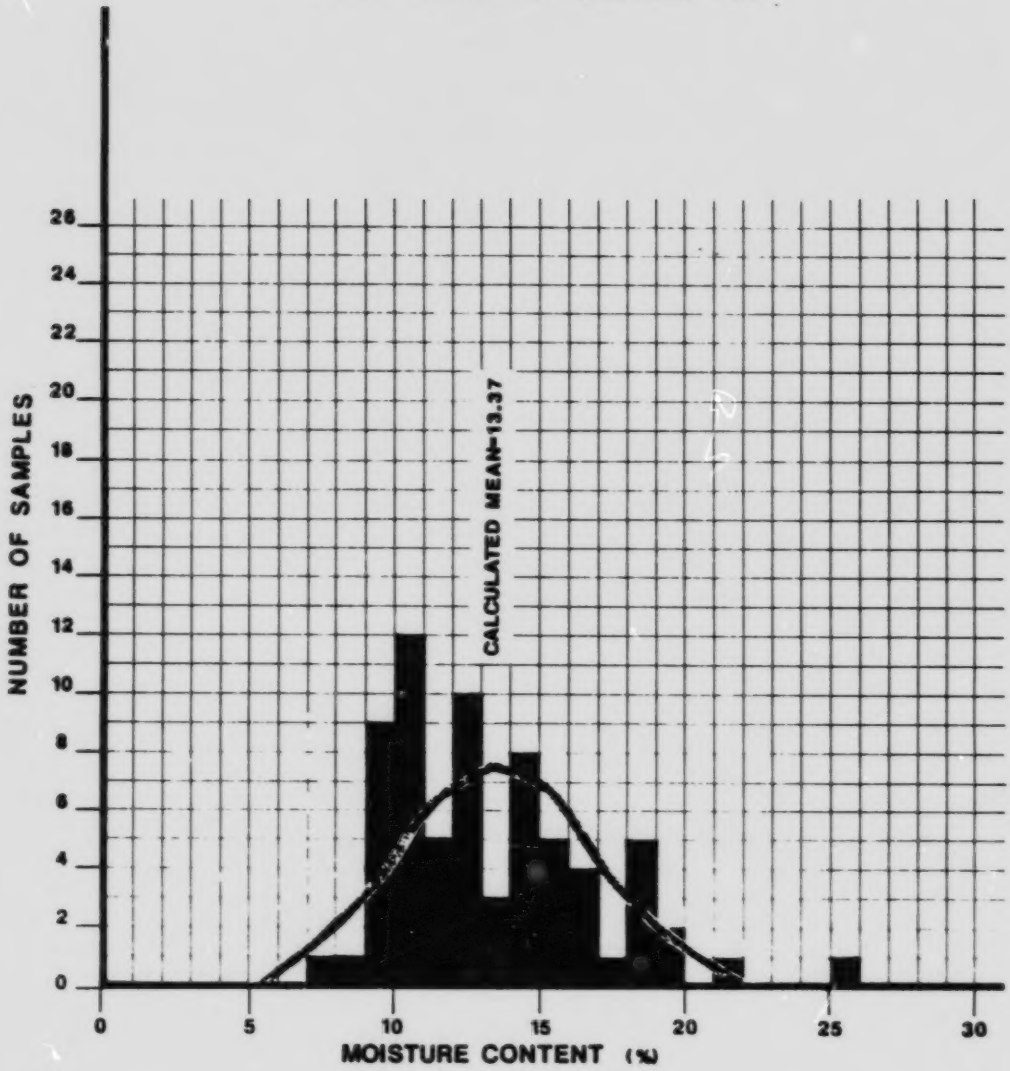
## EXTERIOR STUD
## MID HEIGHT OF BACKFILL
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



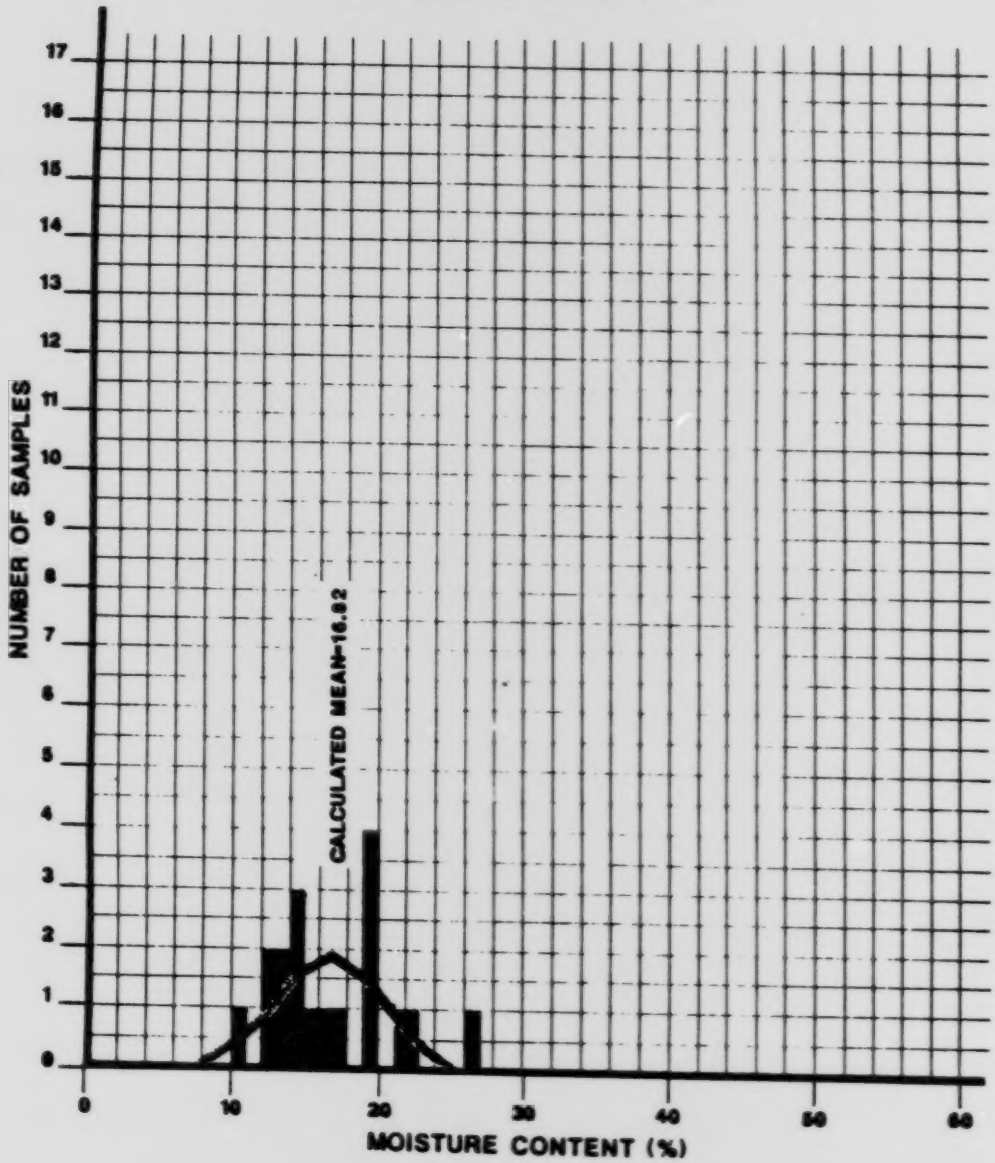
## EXTERIOR STUD
## 3" ABOVE BASE PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 66



## EXTERIOR STUD
## BASE PLATE
### POSITIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 18



## Appendix D Wood Samples

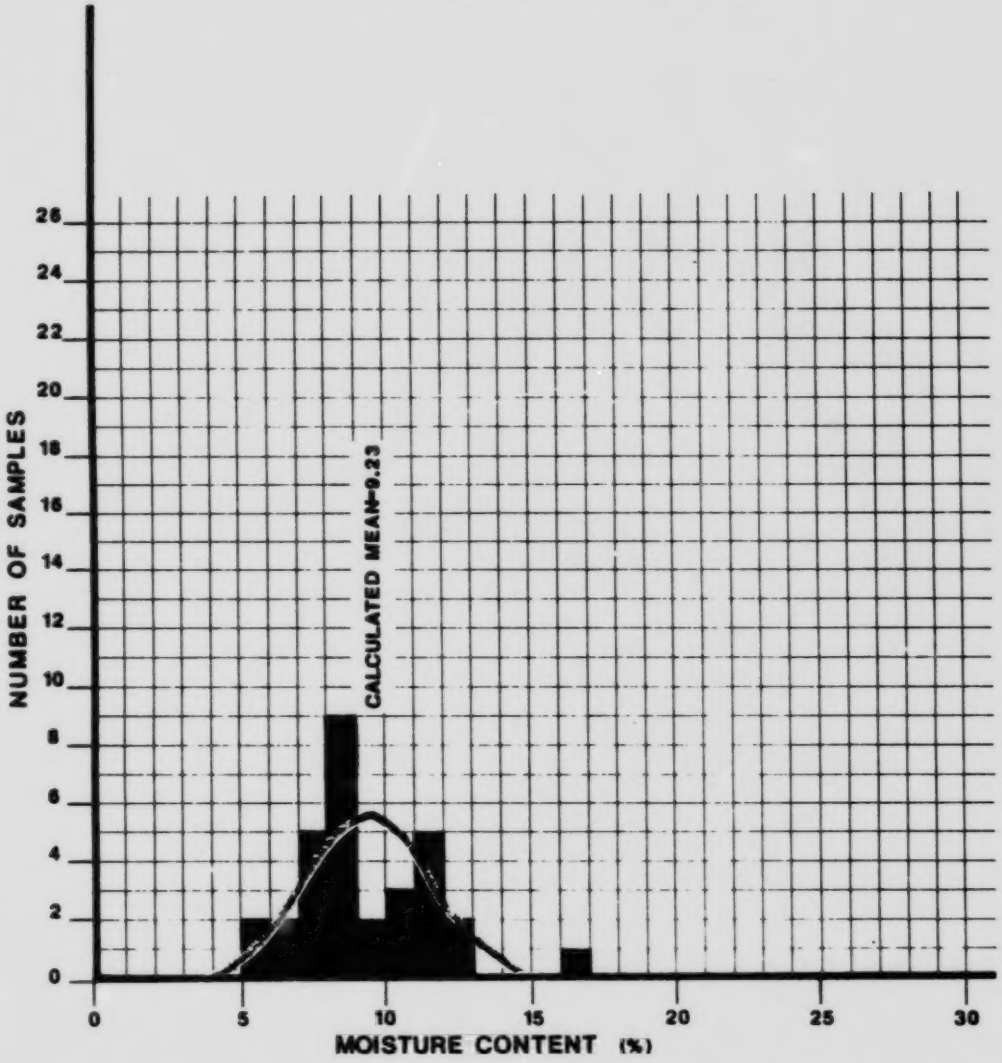
### Part V Moisture Contents With Negative Backfill Drainage

The plots on pages D34 to D44 are normal distribution plots of the moisture contents taken where the exterior drainage is negative, the calculated mean and the best fit normal distribution curve.

## FLOOR JOISTS

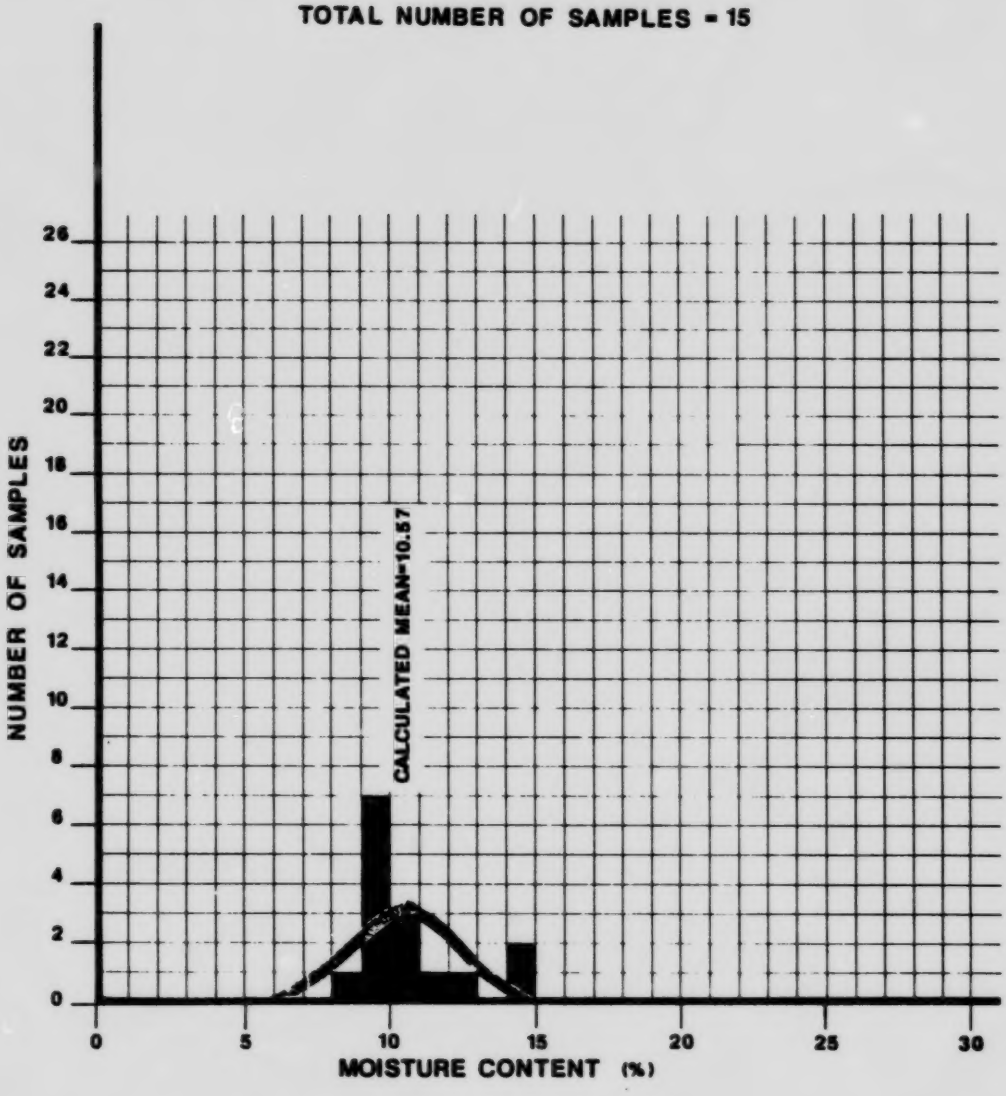
**NEGATIVE DRAINAGE**

**TOTAL NUMBER OF SAMPLES = 31**



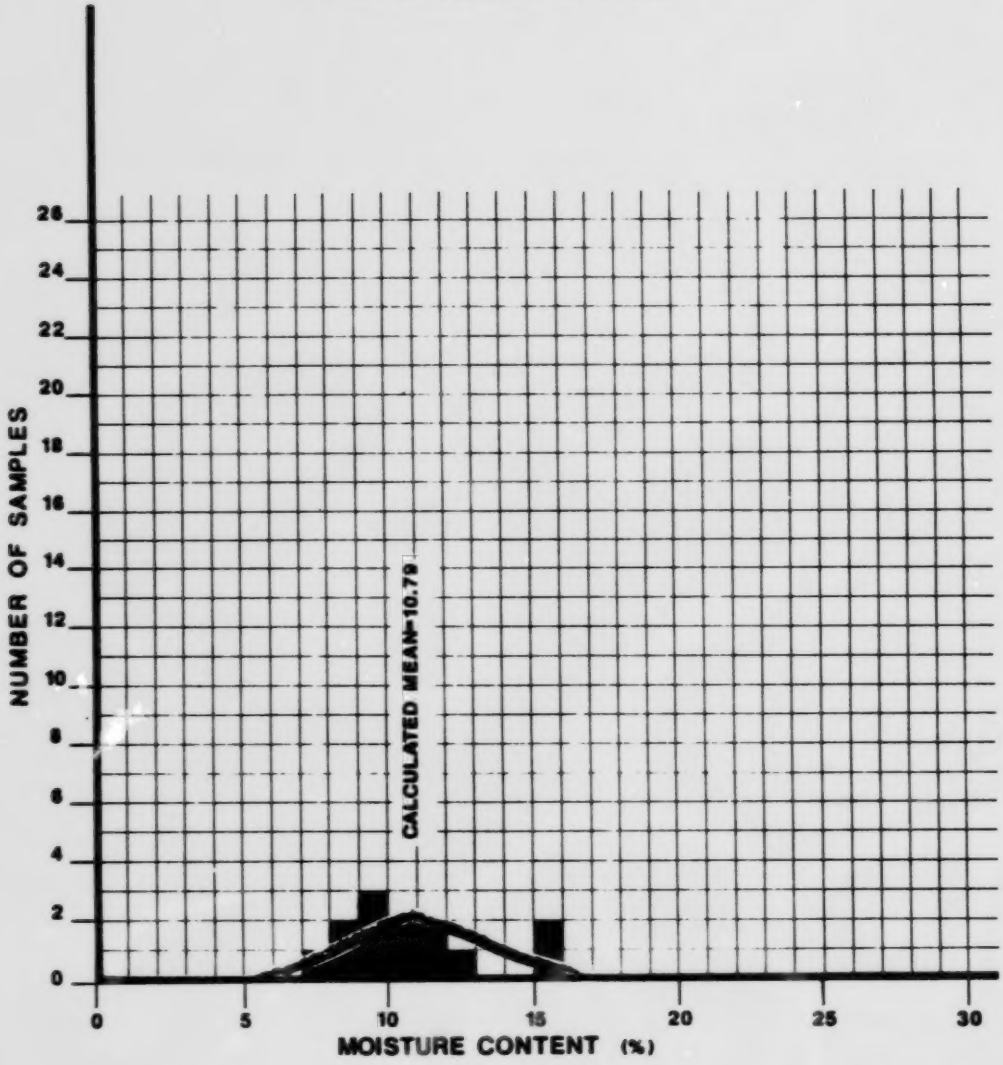
## INTERIOR STUD
## 3" ABOVE BASE PLATE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 15



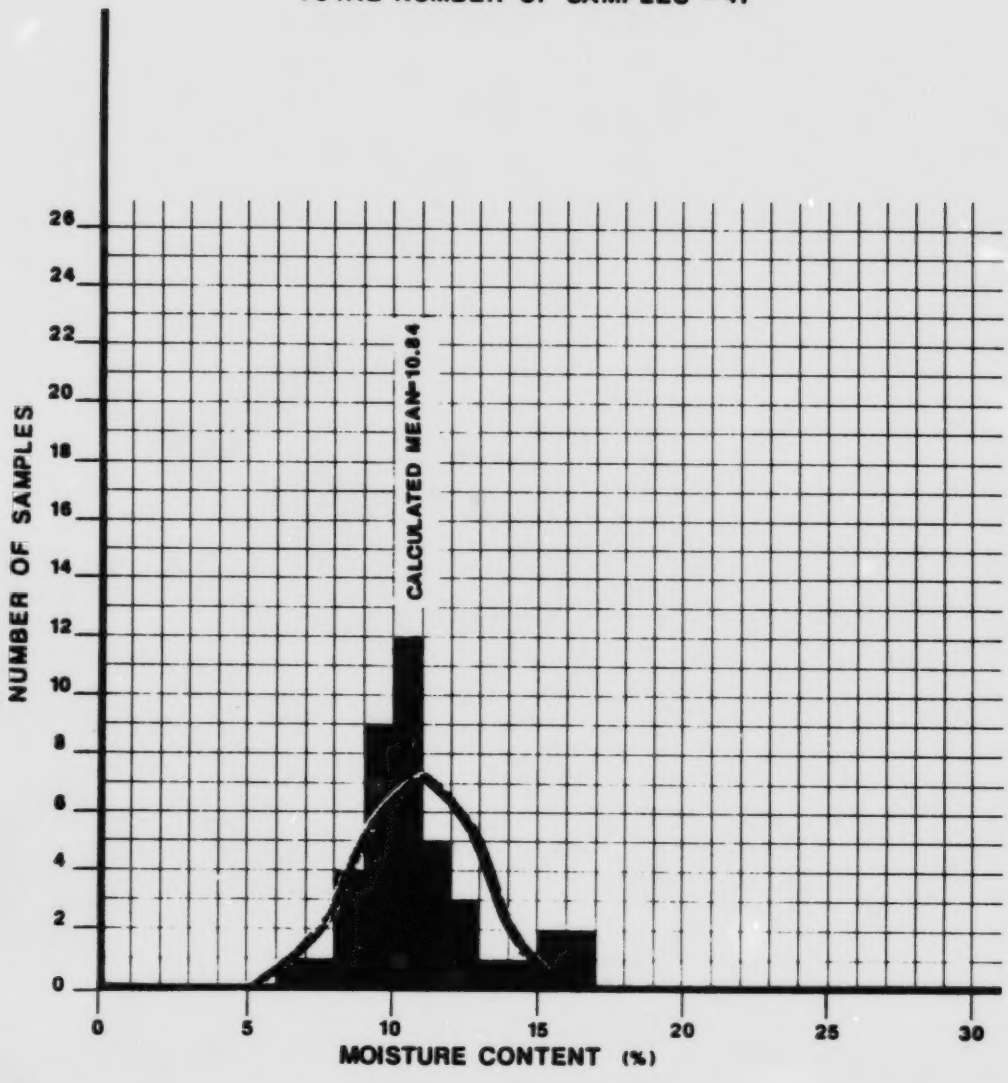
## INTERIOR STUD
## BASE PLATE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 13



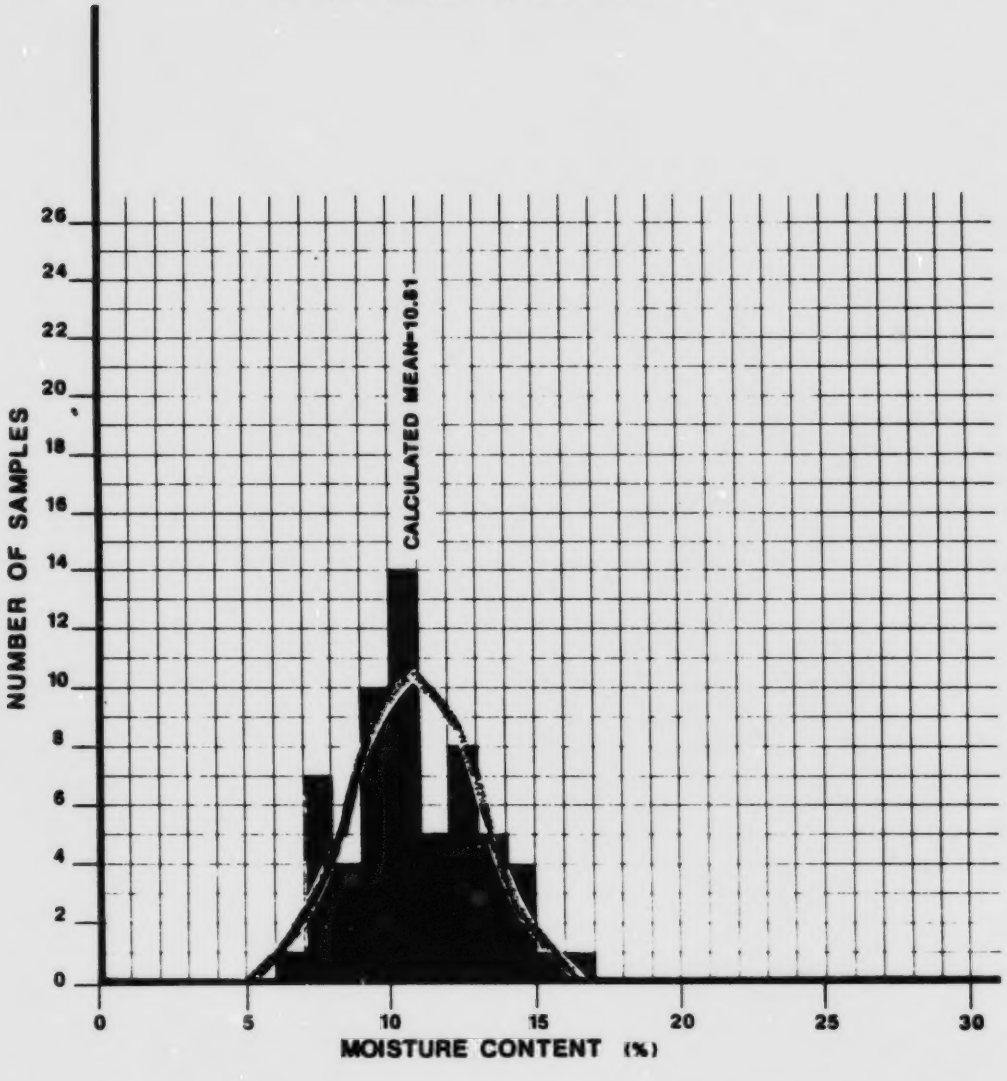
## EXTERIOR STUD
## TOP PLATE AND CAP PLATE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 41



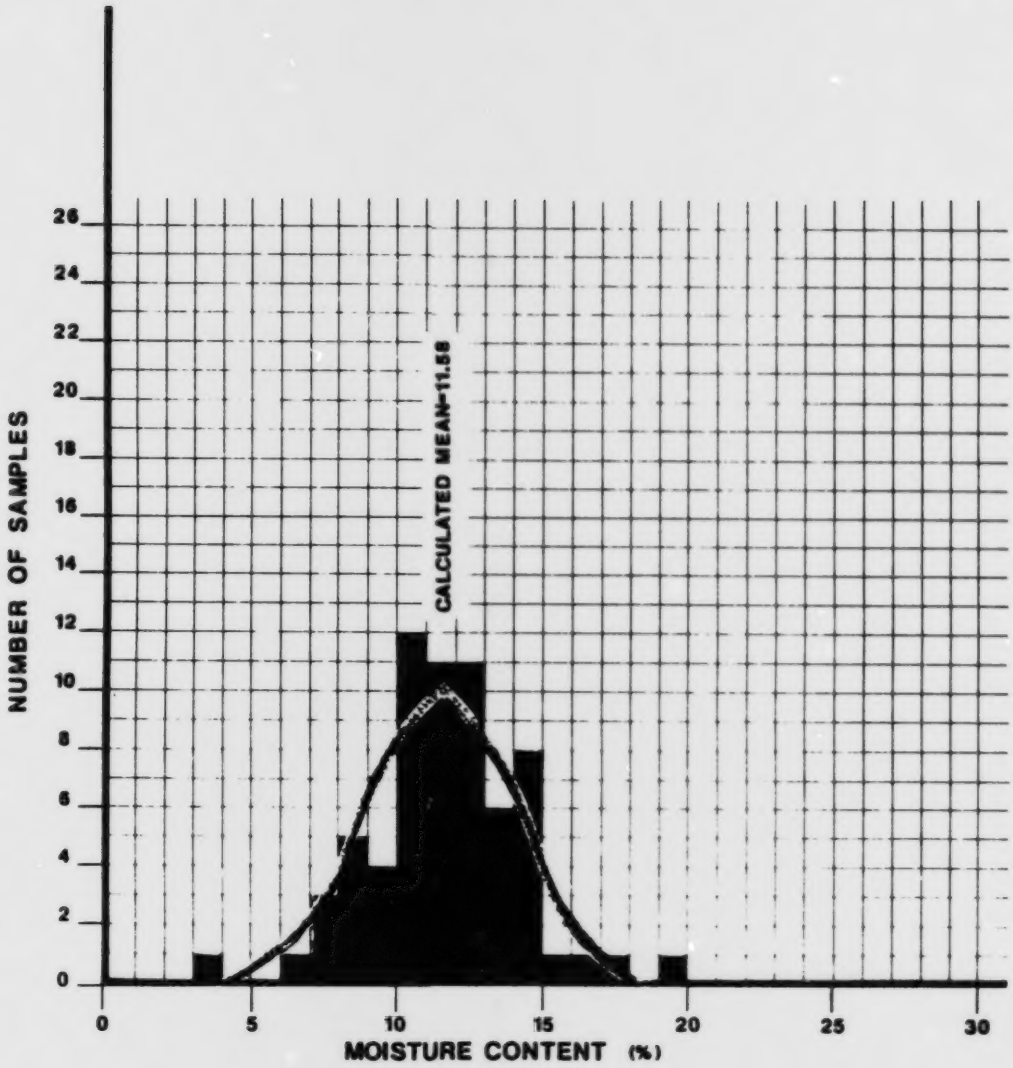
## EXTERIOR STUD
## 3" BELOW TOP PLATE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 60



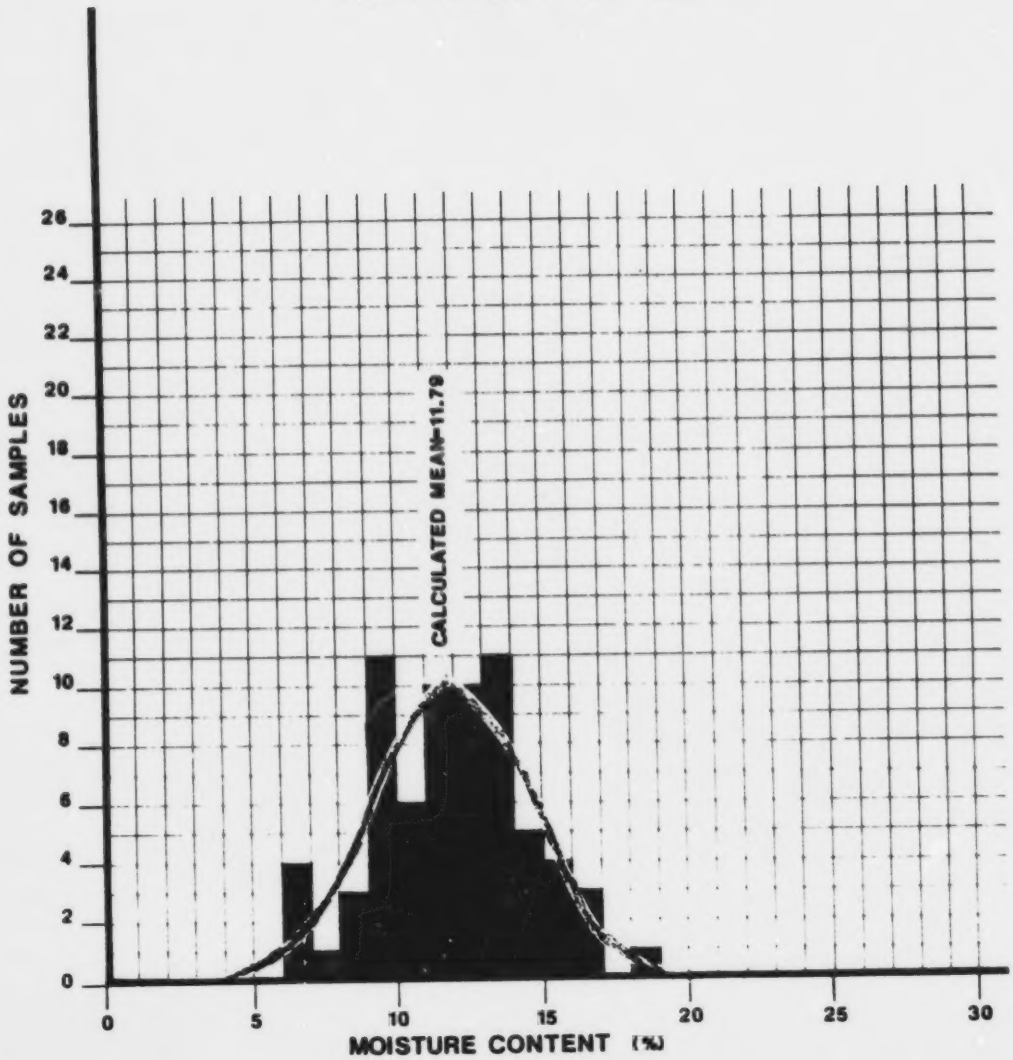
## EXTERIOR STUD
## 12" ABOVE GRADE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 66



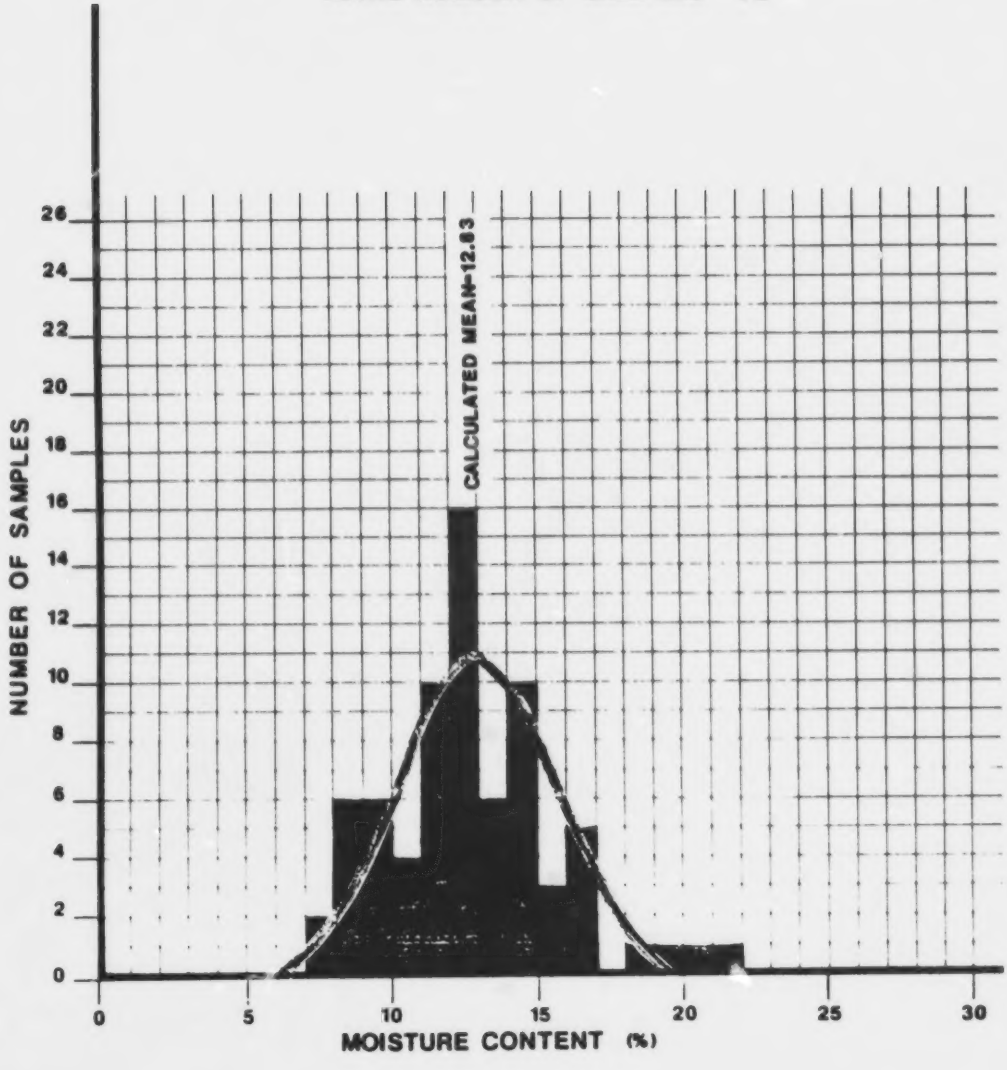
## EXTERIOR STUD
## TOP OF GRADE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 69



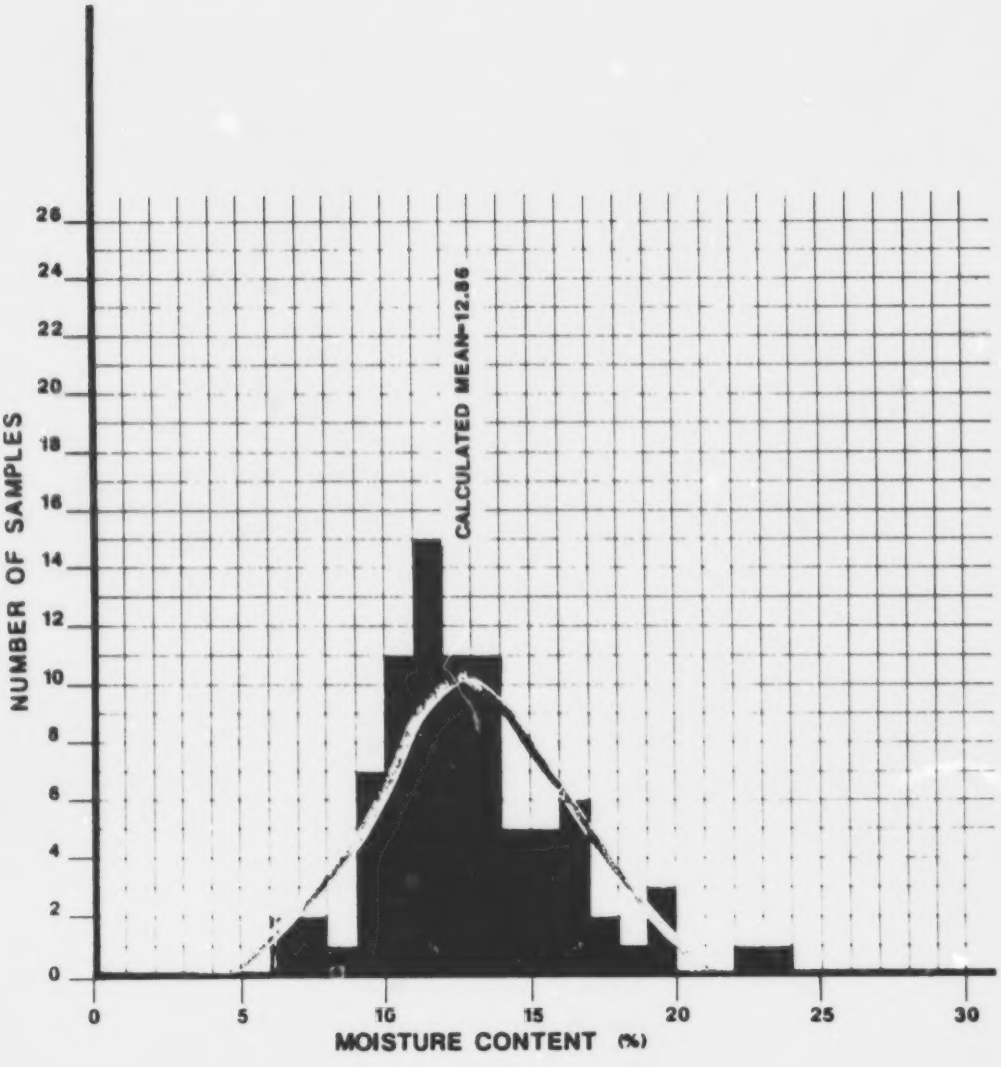
## EXTERIOR STUD
## 12" BELOW GRADE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 72

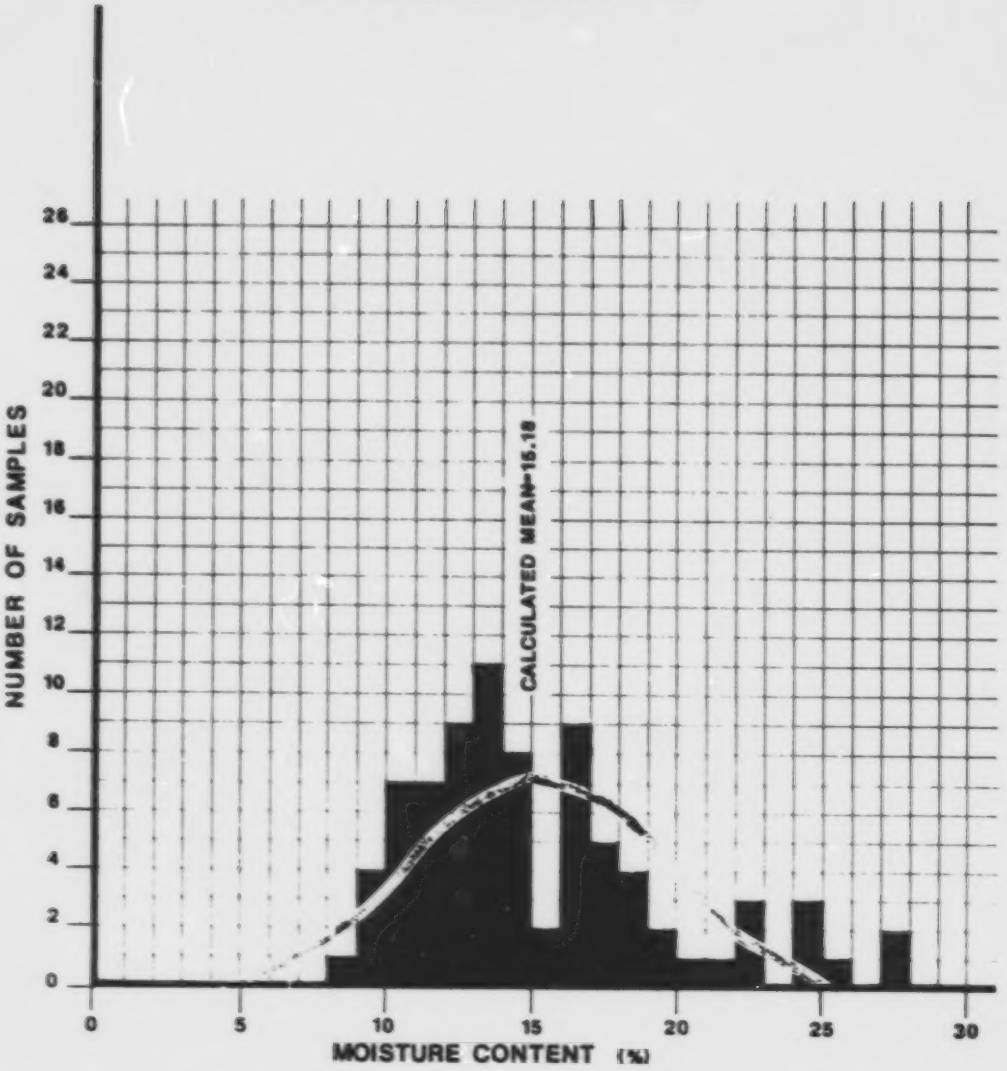


## EXTERIOR STUD
## MID HEIGHT OF BACKFILL
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 84

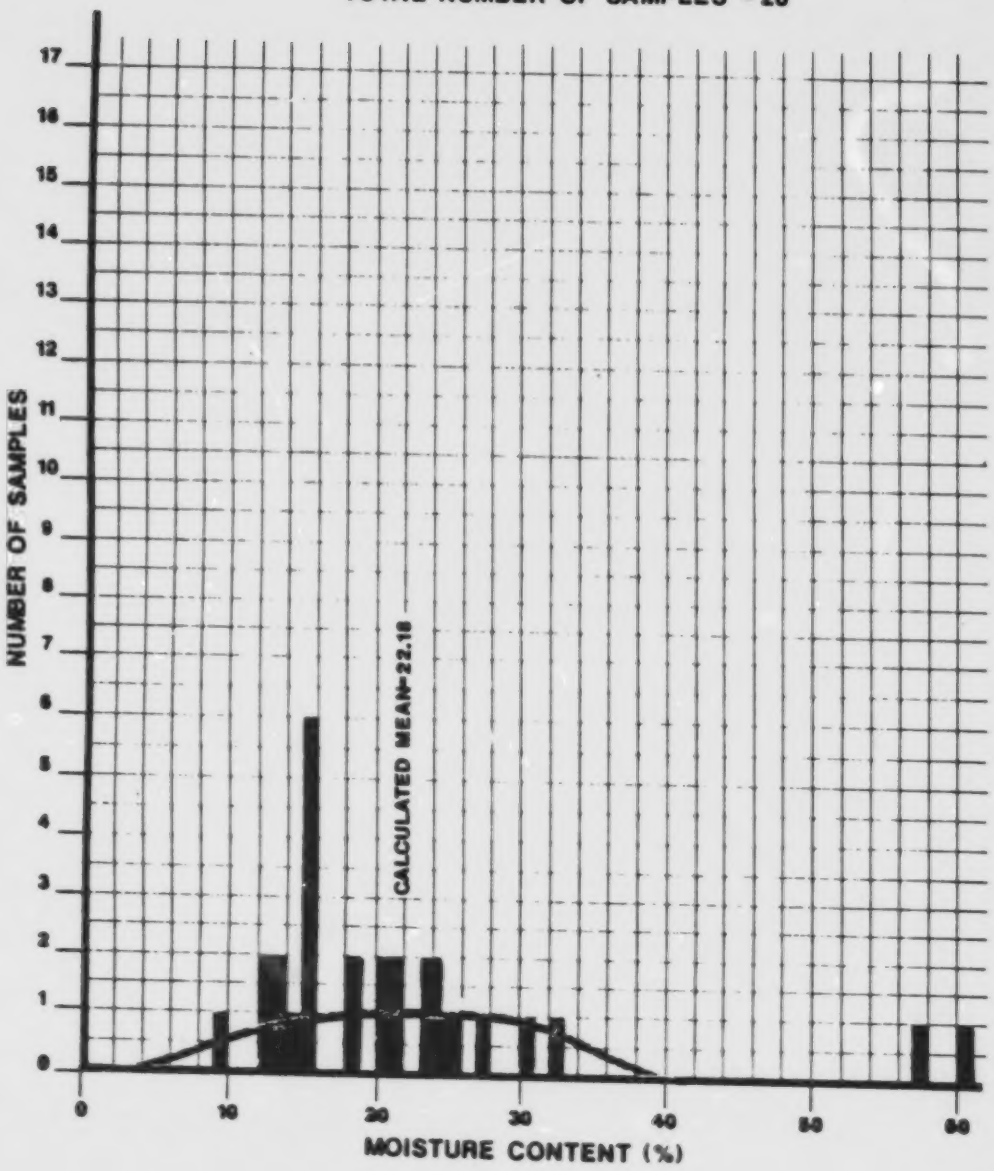


## EXTERIOR STUD
## 3" ABOVE BASE PLATE
### NEGATIVE DRAINAGE
### TOTAL NUMBER OF SAMPLES = 80



## EXTERIOR STUD
## BASE PLATE
### NEGATIVE DRAINAGE

TOTAL NUMBER OF SAMPLES = 28

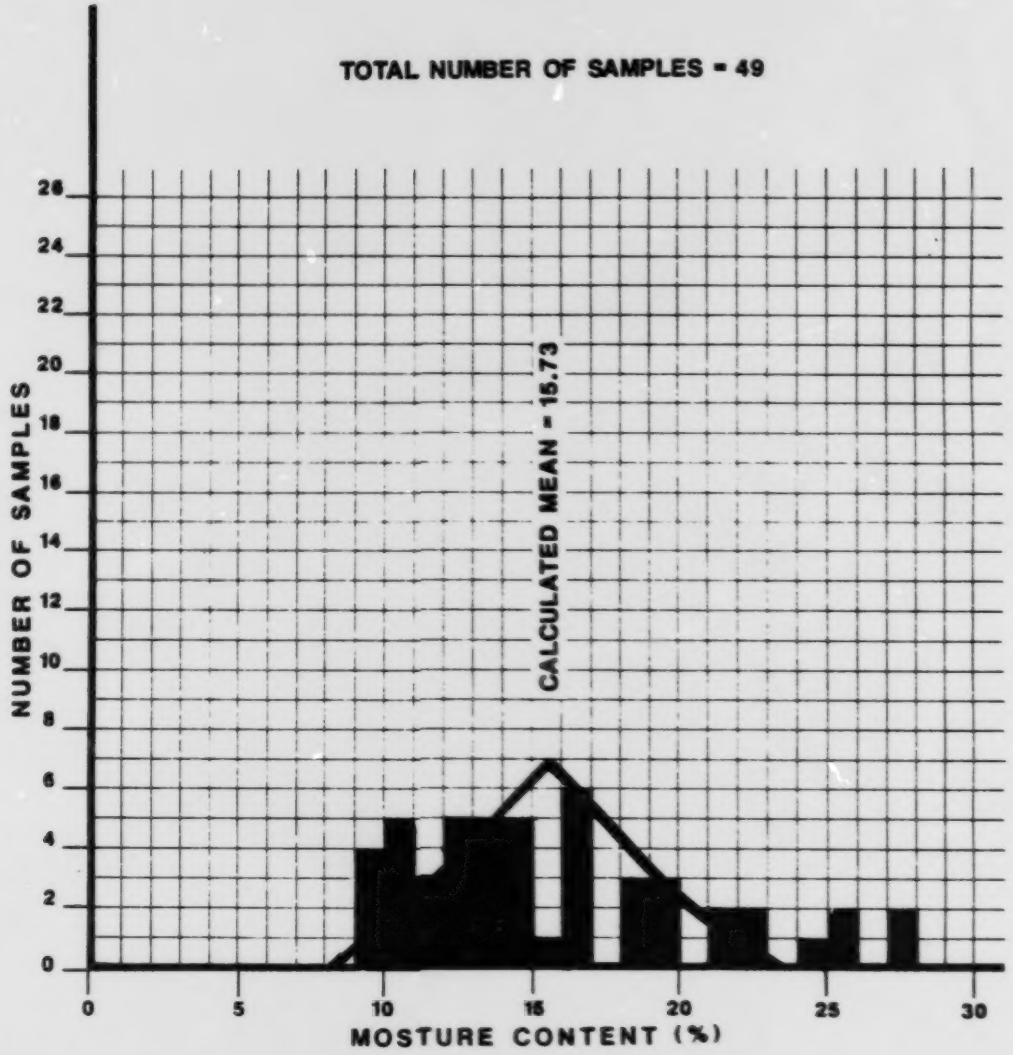


## Appendix D Wood Samples

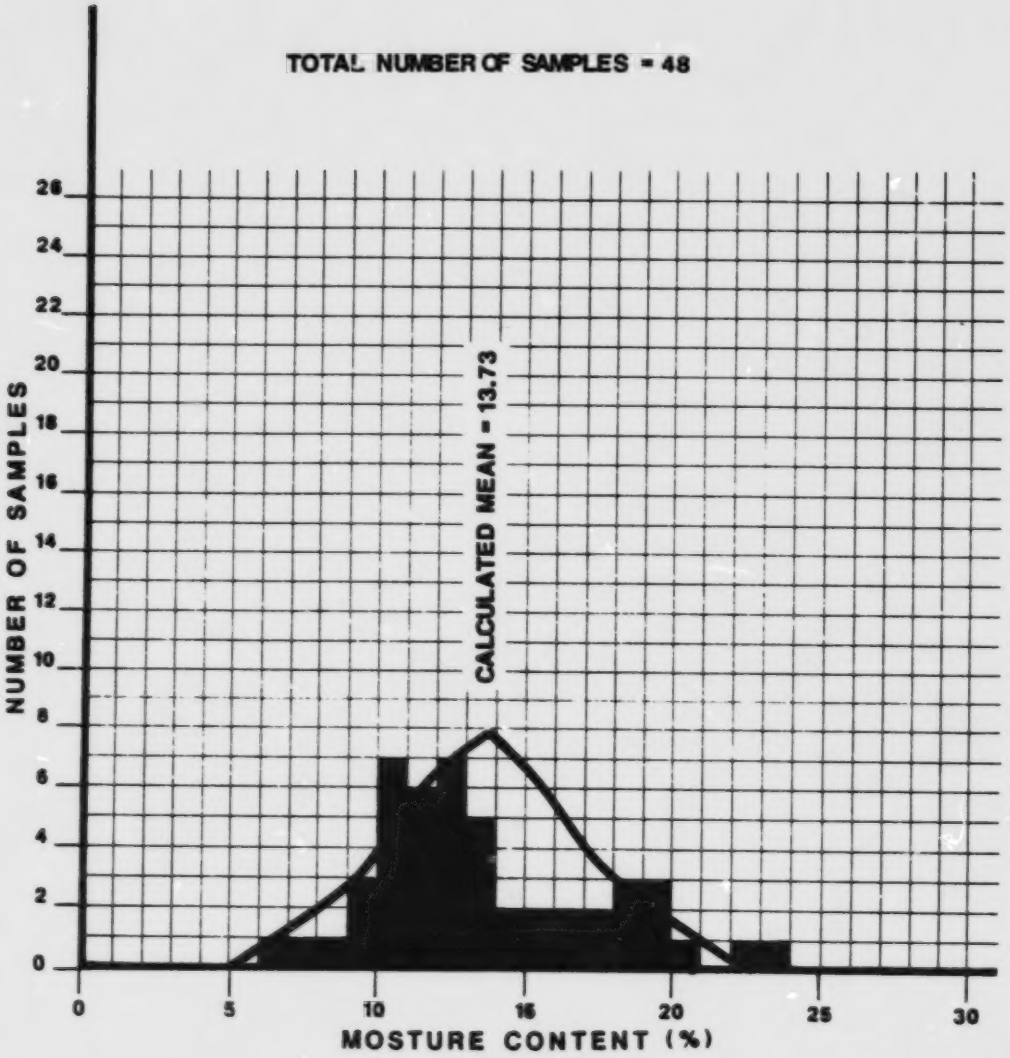
### Part VI Moisture Contents at Specified Sampling Points

The plots on pages D46 to D51 are normal distribution plots of the moisture contents in the outer one third of the stud, the calculated mean and the best fit normal distribution curve.

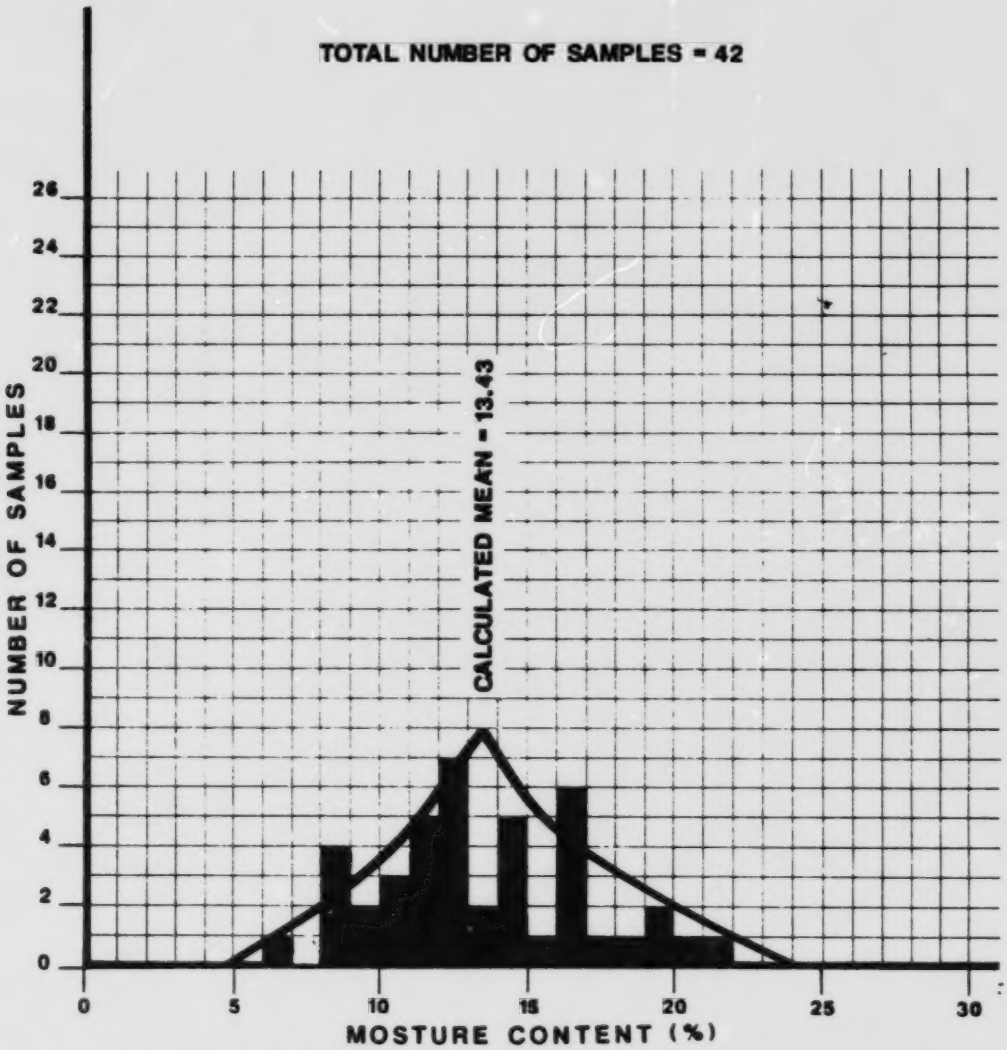
## EXTERIOR STUD
## 3" ABOVE BASE PLATE
### OUTER 1/3"



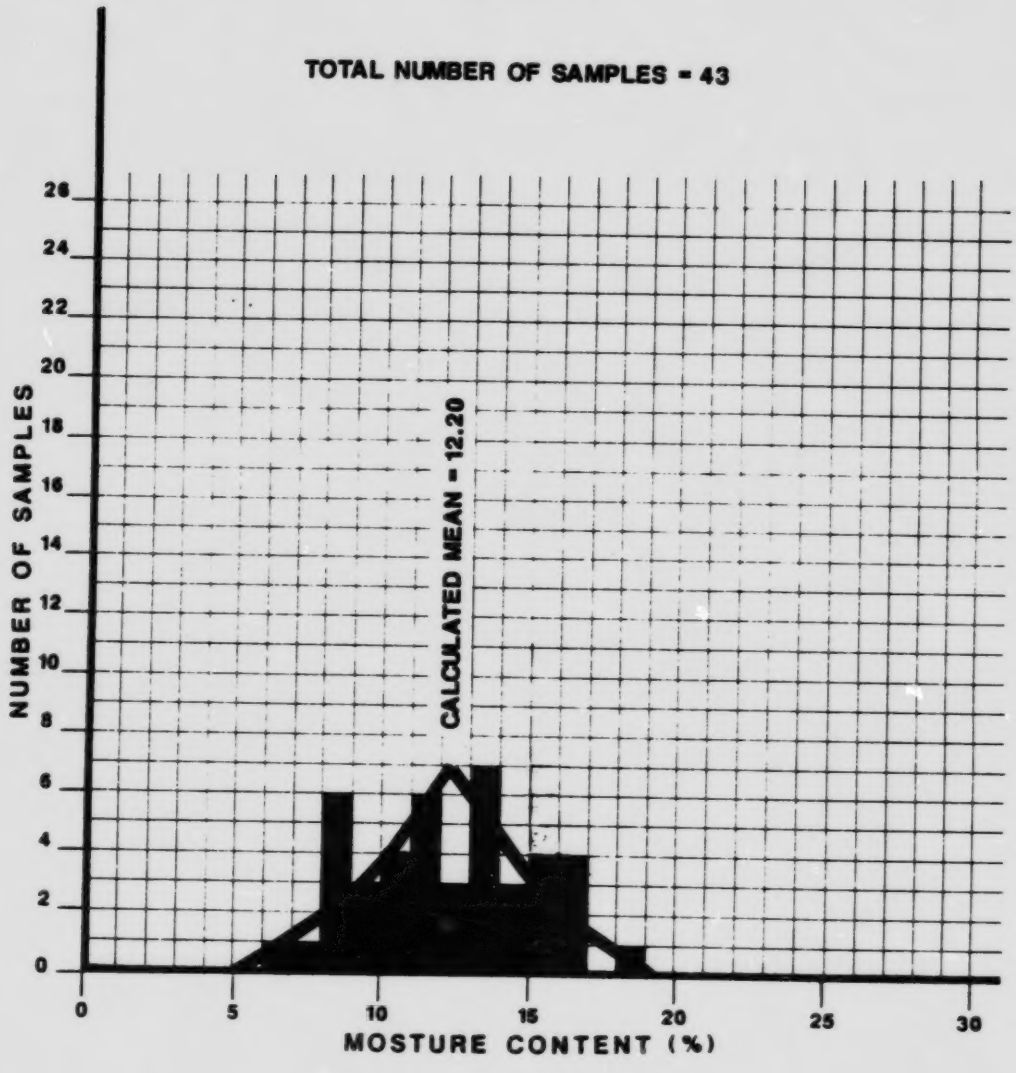
## EXTERIOR STUD
## MID HEIGHT OF BACKFILL
### OUTER 1/3"



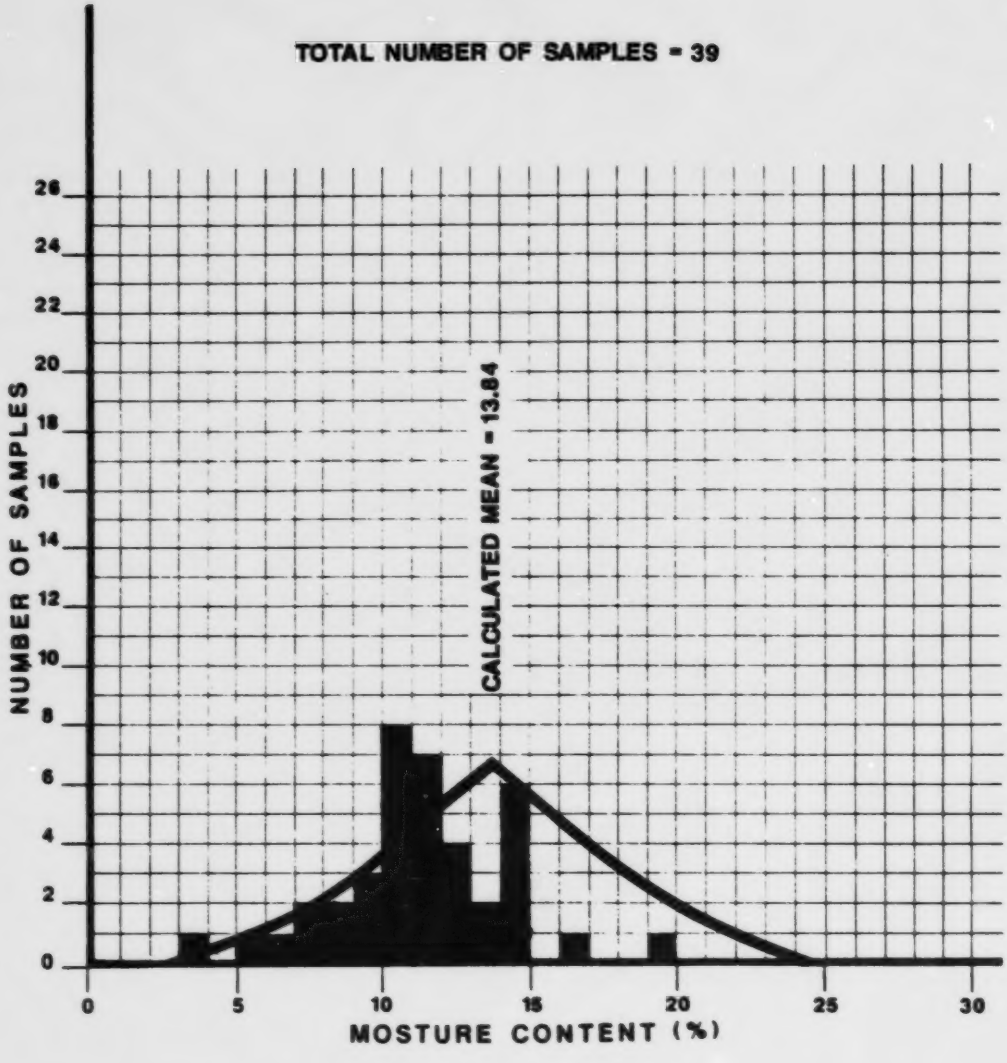
## EXTERIOR STUD
## 12" BELOW GRADE
### OUTER 1/3"



## EXTERIOR STUD
## TOP OF GRADE
### OUTER 1/3"

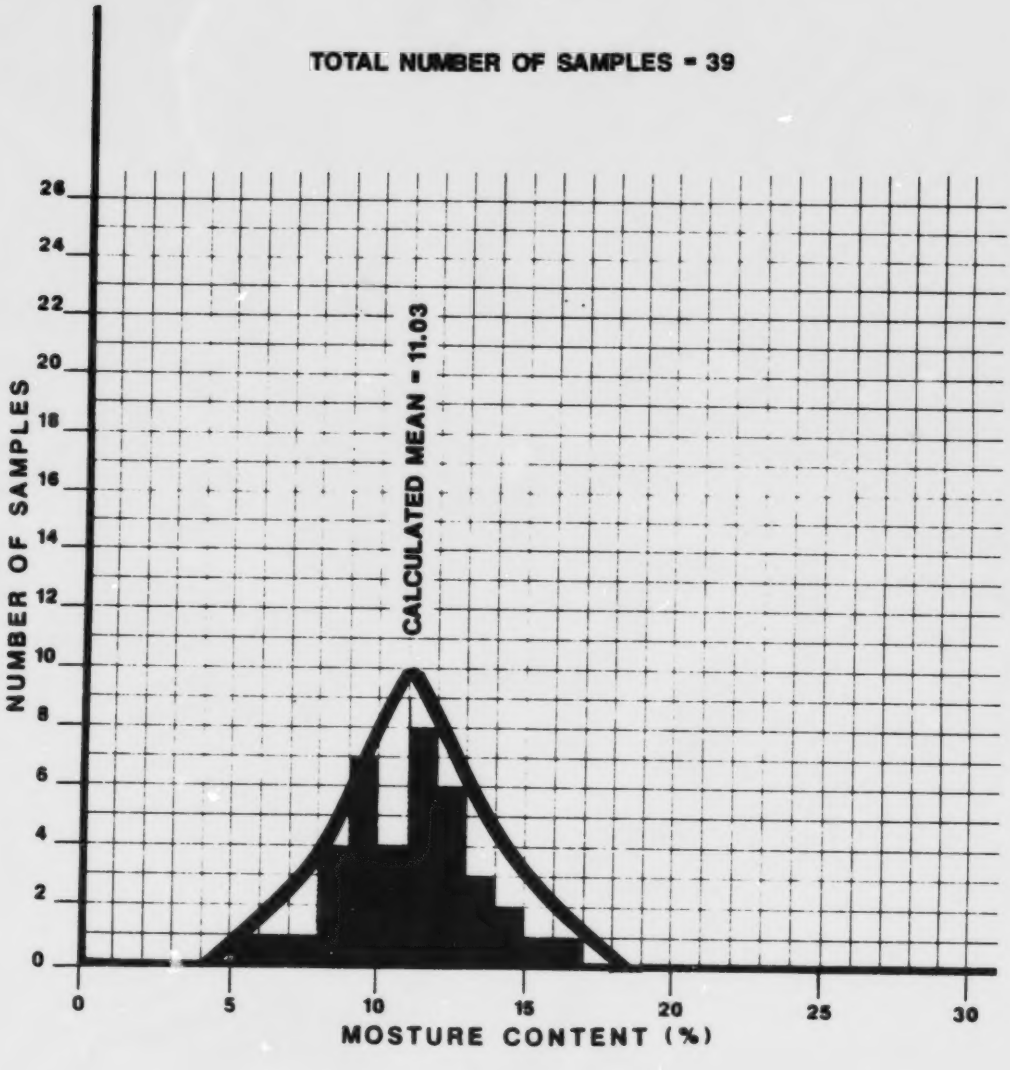


## EXTERIOR STUD
## 12" ABOVE GRADE
### OUTER 1/3"



## EXTERIOR STUD
## 3" BELOW TOP PLATE
### OUTER 1/3"

TOTAL NUMBER OF SAMPLES = 39

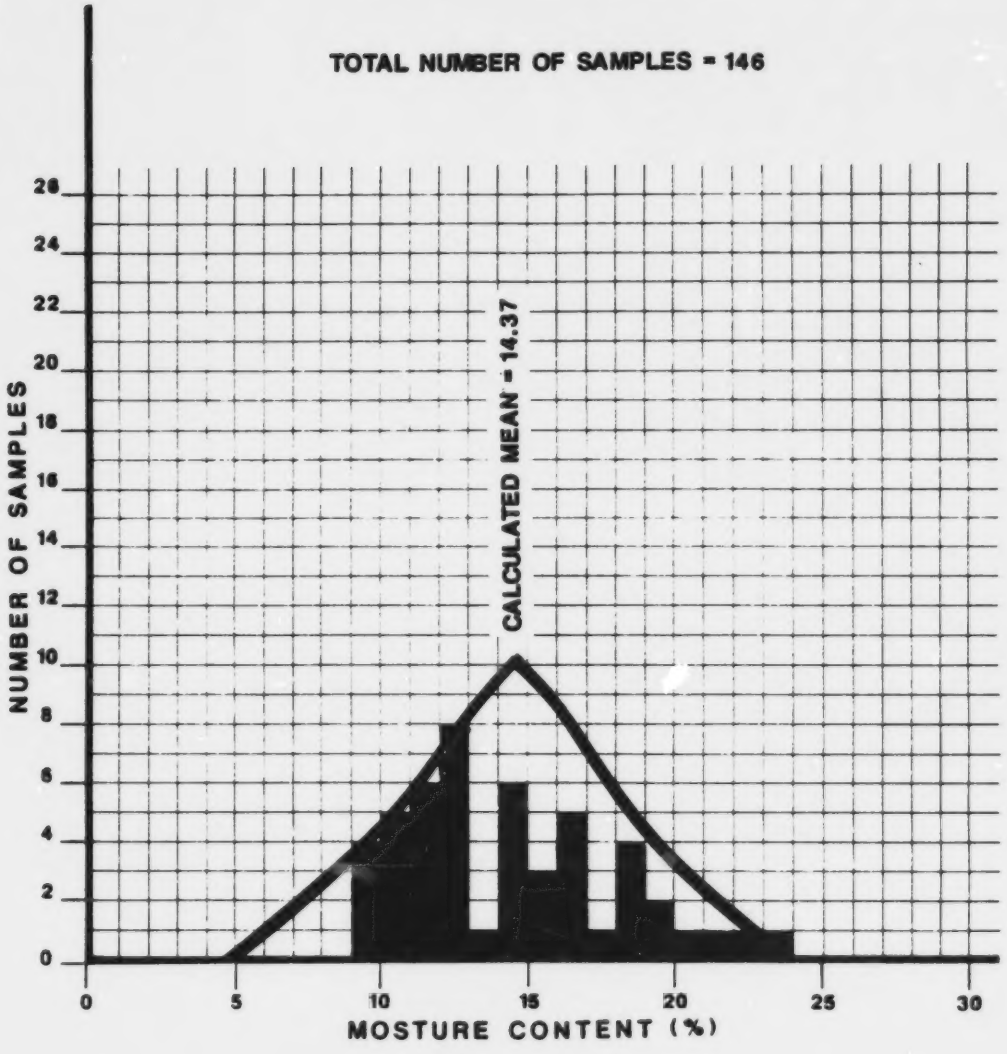


## Appendix D Wood Samples

### Part VII Mean Moisture Contents at Specified Sampling Points

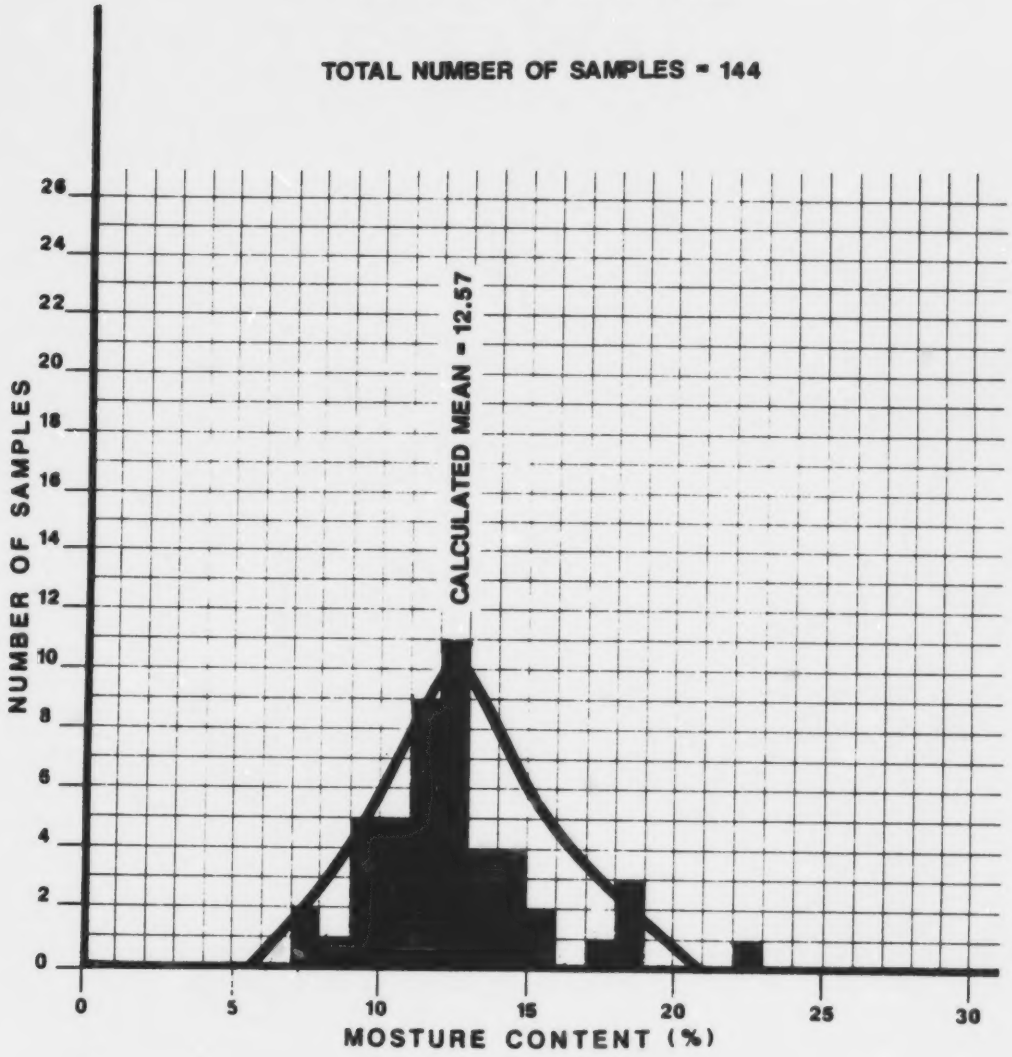
The plots on pages D53 to D58 are normal distribution plots of the mean moisture contents of the PWF studs at the specified sampling location, the calculated mean and the best fit normal distribution curve.

## EXTERIOR STUD
## 3" ABOVE BASE PLATE
### AVERAGE VALUE ACROSS STUD

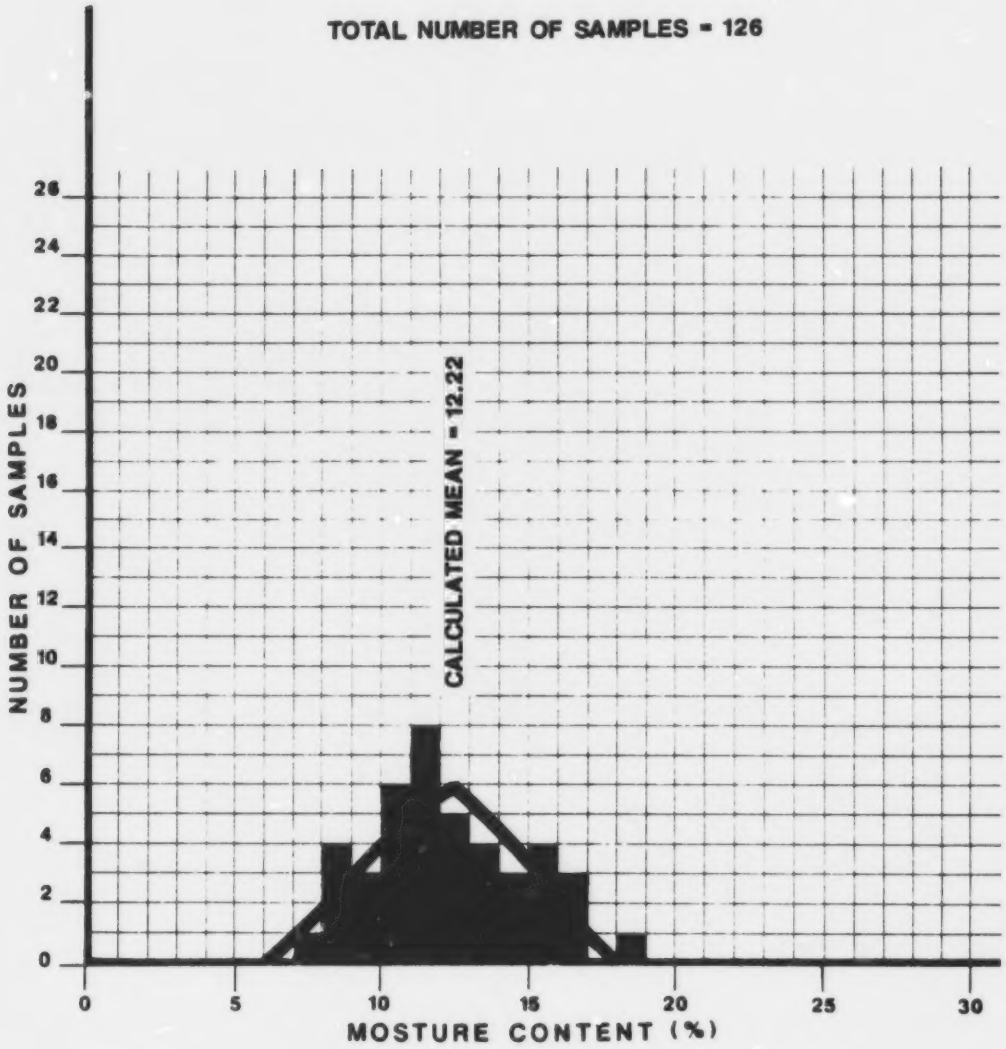


EXTERIOR STUD
MID HEIGHT OF BACKFILL
AVERAGE VALUE ACROSS STUD

TOTAL NUMBER OF SAMPLES = 144

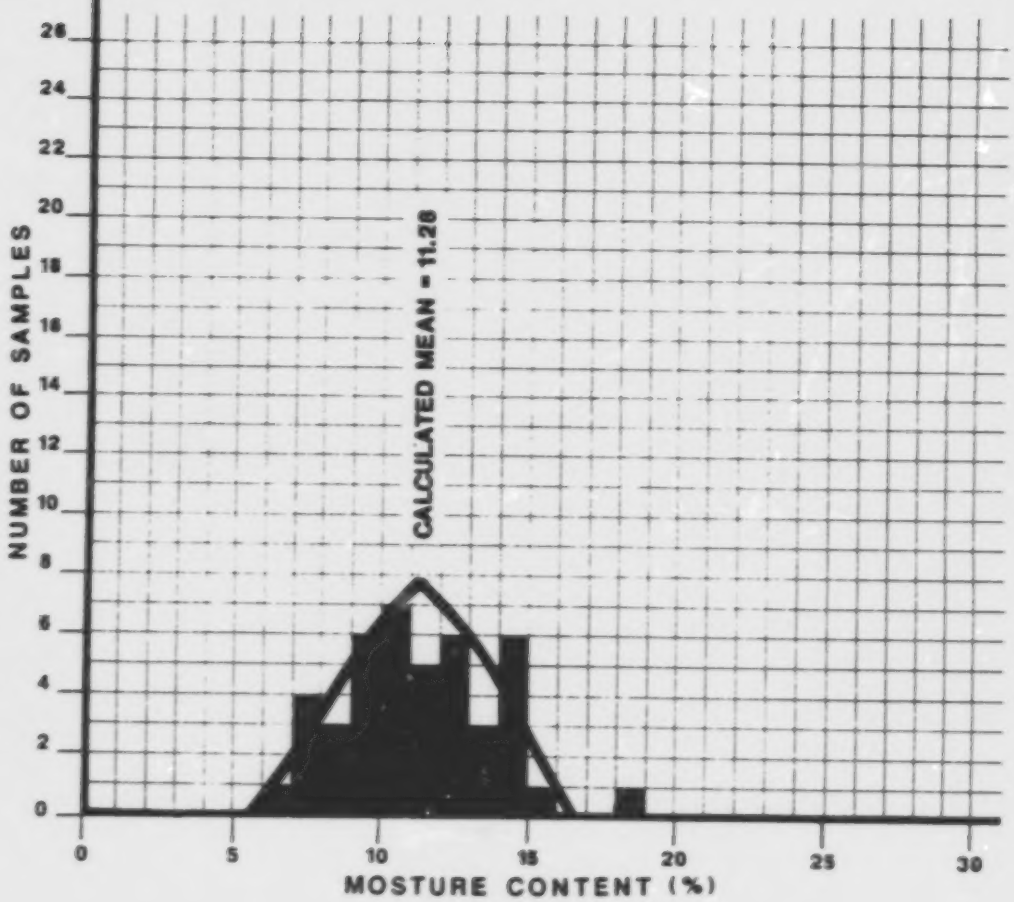


## EXTERIOR STUD
## 12" BELOW GRADE
### AVERAGE VALUE ACROSS STUD



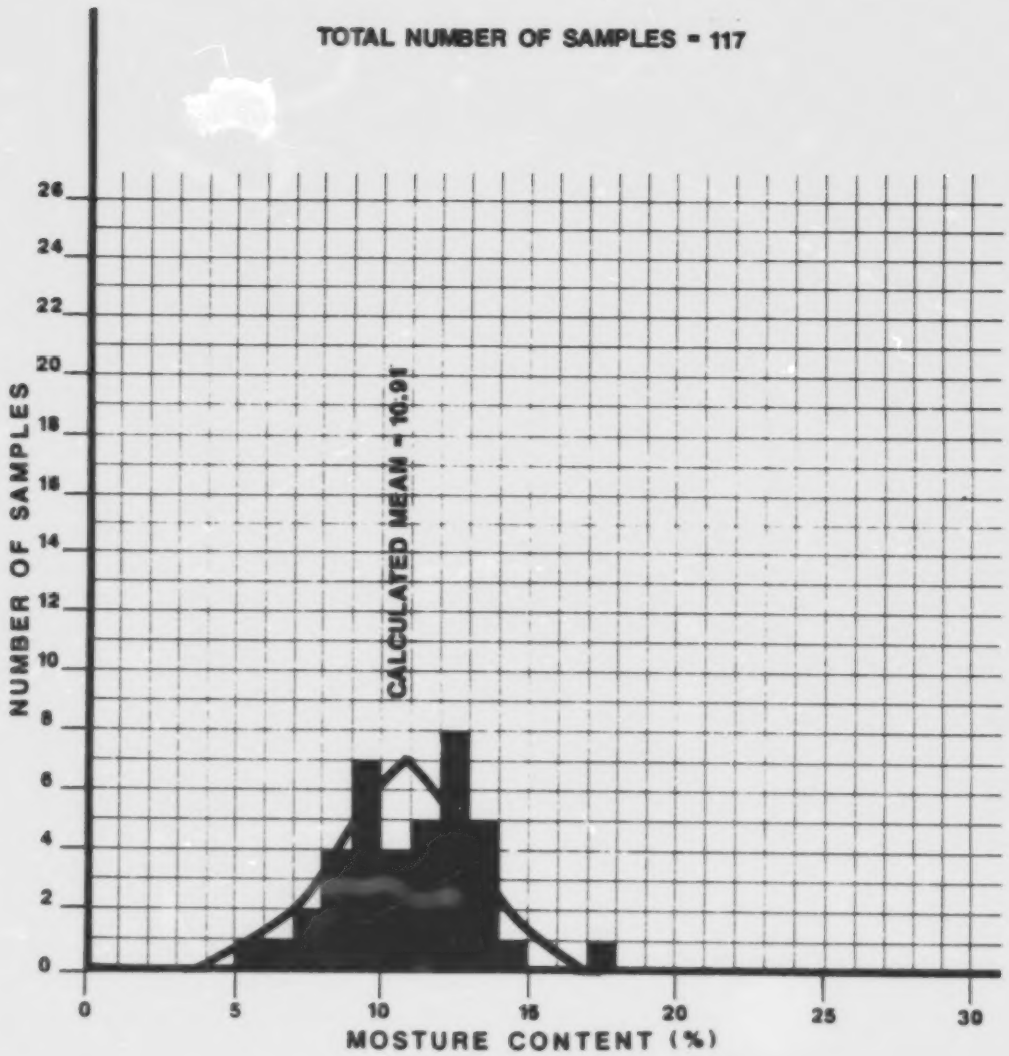
## EXTERIOR STUD
## TOP OF GRADE
### AVERAGE VALUE ACROSS STUD

TOTAL NUMBER OF SAMPLES = 129



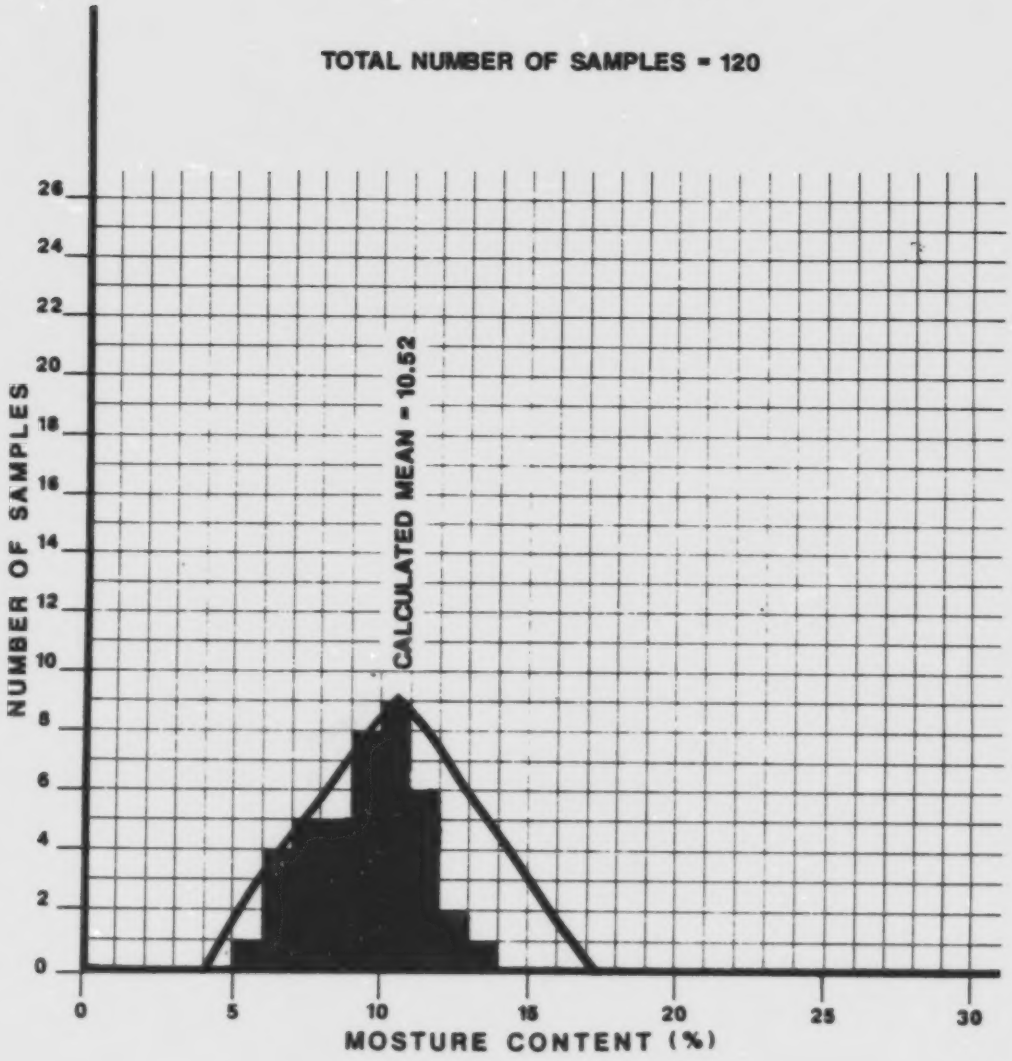
## EXTERIOR STUD
## 12" ABOVE GRADE
### AVERAGE VALUE ACROSS STUD

TOTAL NUMBER OF SAMPLES = 117



## EXTERIOR STUD
## 3" BELOW TOP PLATE
### AVERAGE VALUE ACROSS STUD

TOTAL NUMBER OF SAMPLES = 120

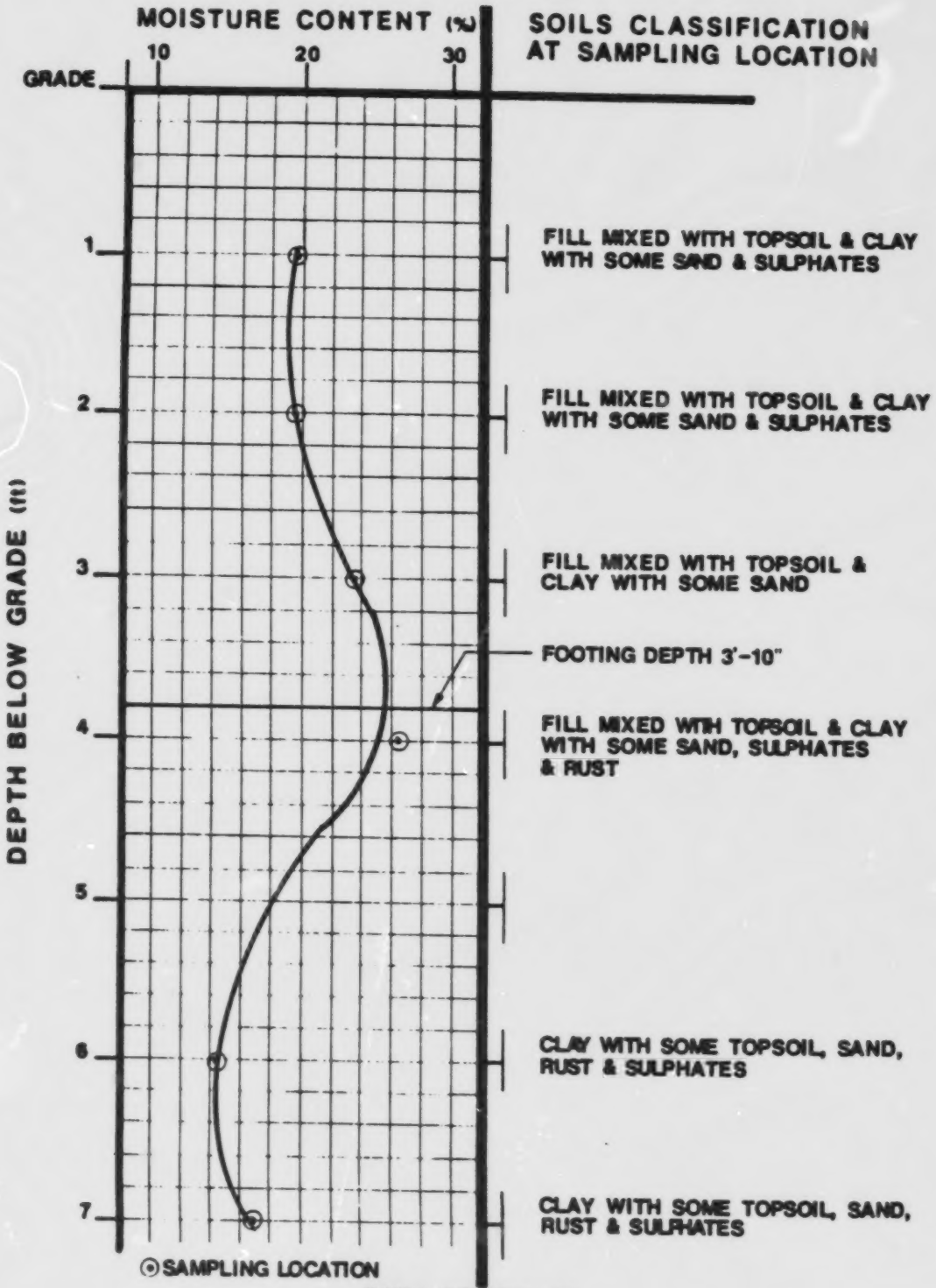


## Appendix E Soil Samples

### Part I Moisture Content and Soil Classification Plots.

The plots on pages E2 to E33 show the moisture profile of the soil at various depths below finished grade and the soils classification of the sample taken for testing.

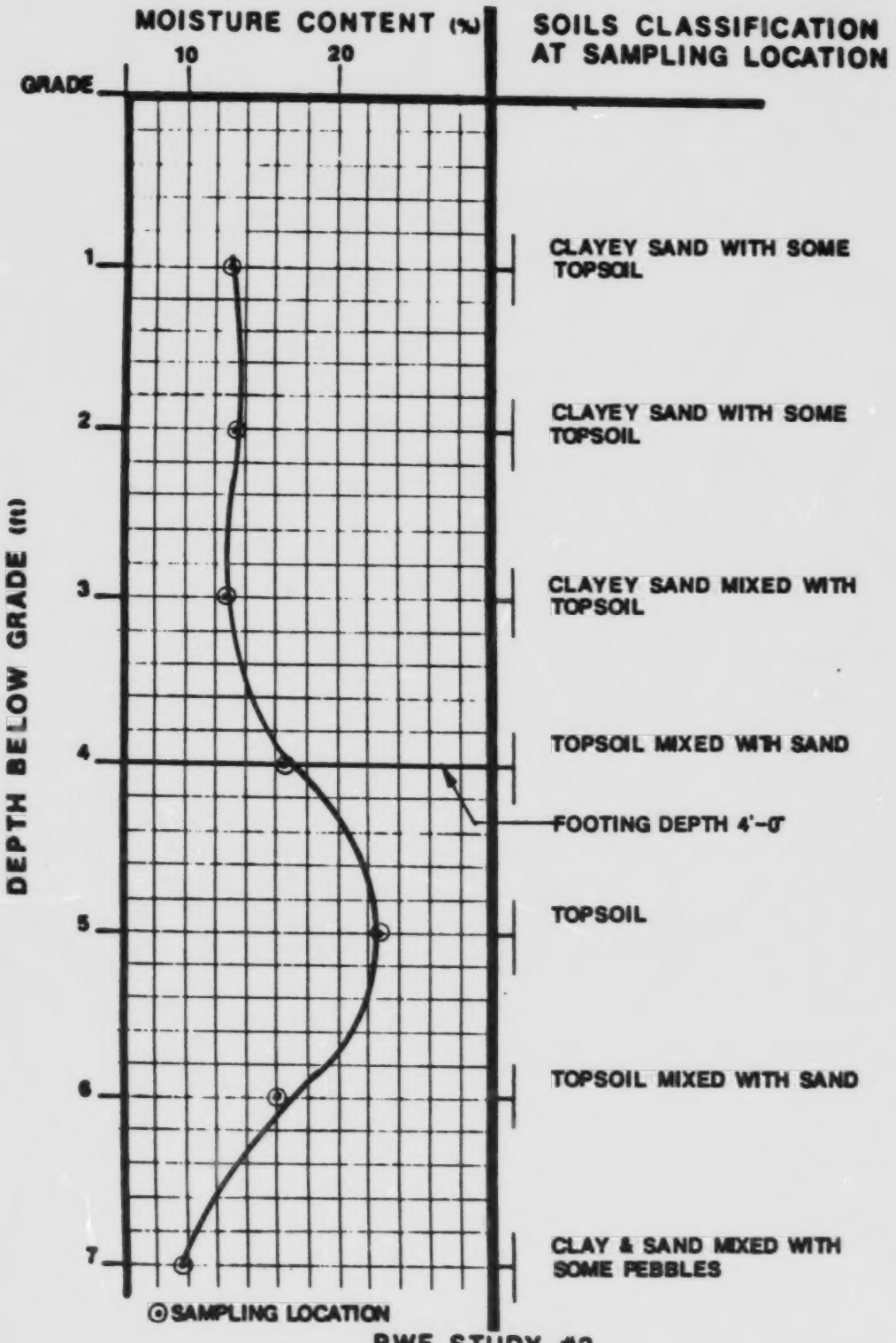
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL


MOISTURE CONTENT (%)
10
20
30
SOILS CLASSIFICATION AT SAMPLING LOCATION
GRADE
1
2
3
4
5
6
7
DEPTH BELOW GRADE (ft)
FILL MIXED WITH TOPSOIL & CLAY WITH SOME SAND & SULPHATES
FILL MIXED WITH TOPSOIL & CLAY WITH SOME SAND & SULPHATES
FILL MIXED WITH TOPSOIL & CLAY WITH SOME SAND
FOOTING DEPTH 3'-10"
FILL MIXED WITH TOPSOIL & CLAY WITH SOME SAND, SULPHATES & RUST
CLAY WITH SOME TOPSOIL, SAND, RUST & SULPHATES
CLAY WITH SOME TOPSOIL, SAND, RUST & SULPHATES
⊙SAMPLING LOCATION

PWF STUDY #1

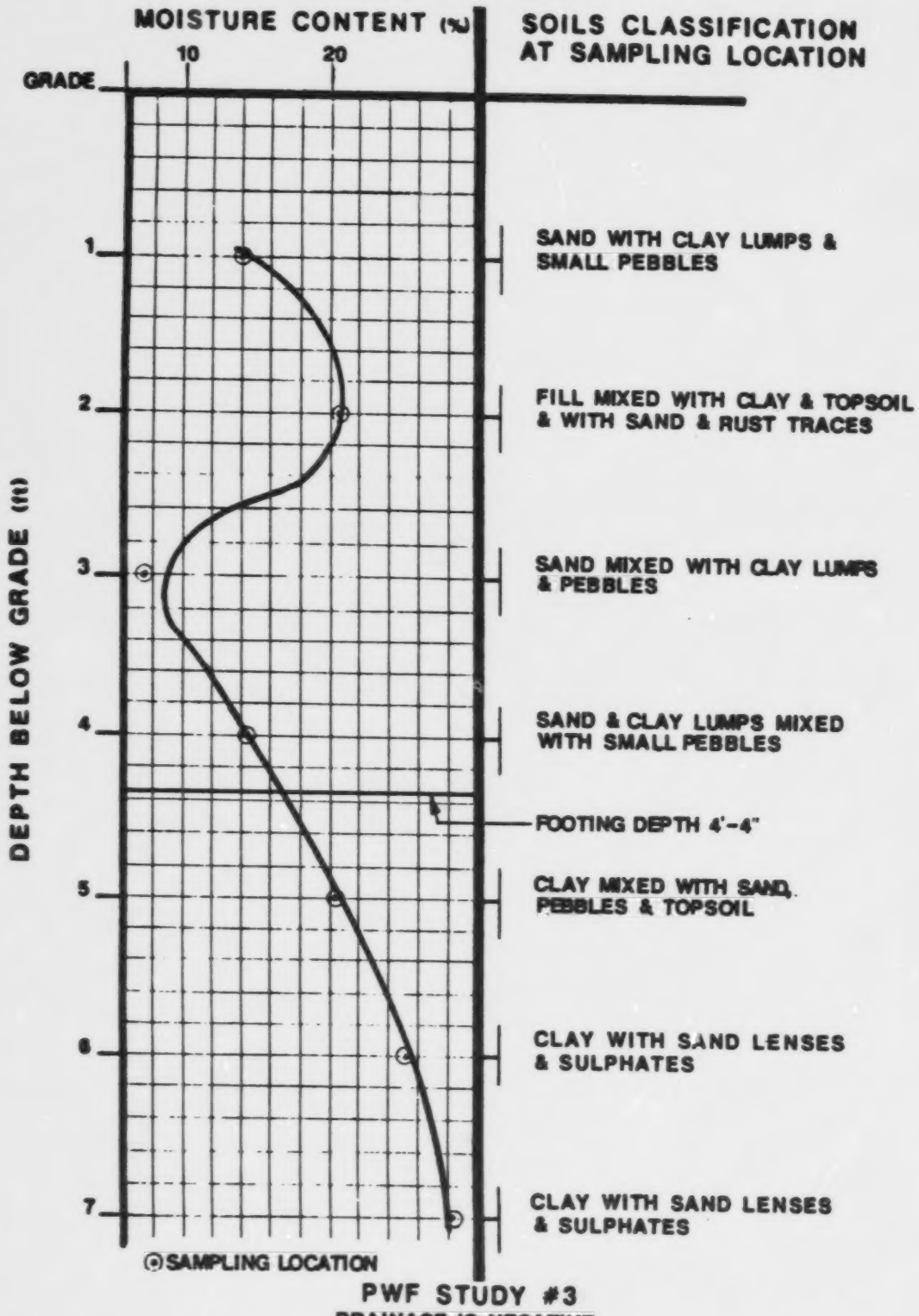
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #2
DRAINAGE IS NEGATIVE

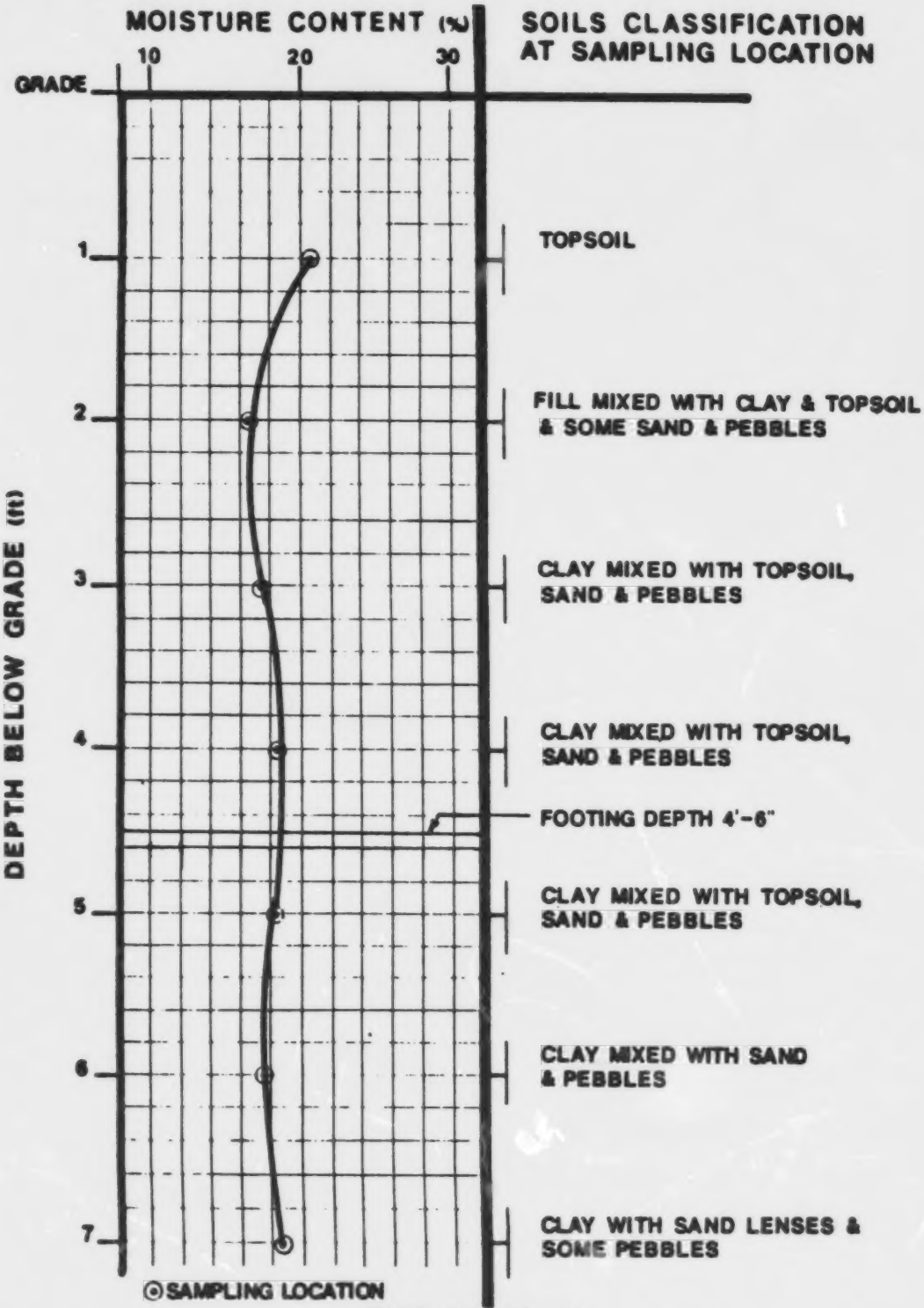
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #3

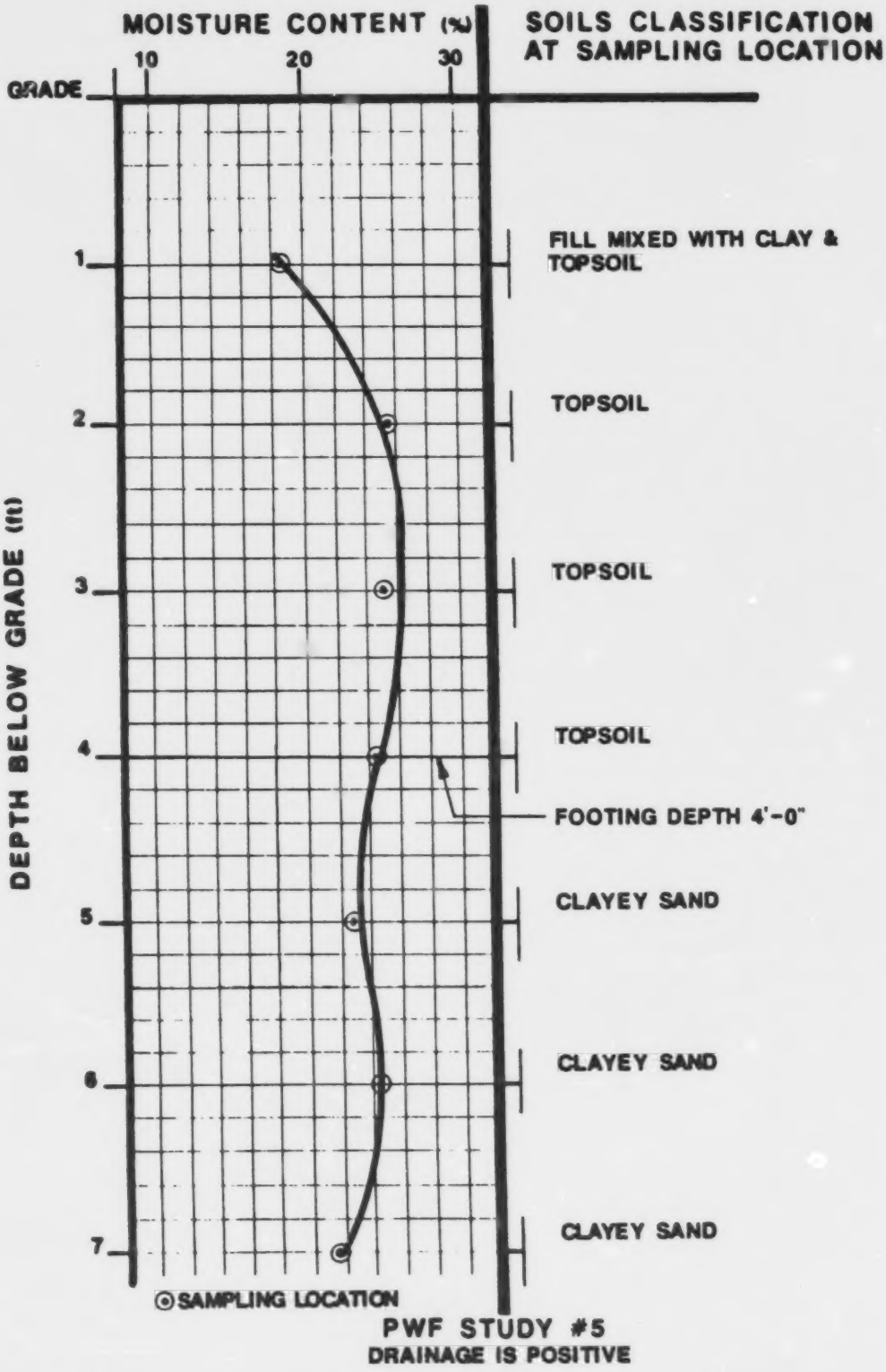
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



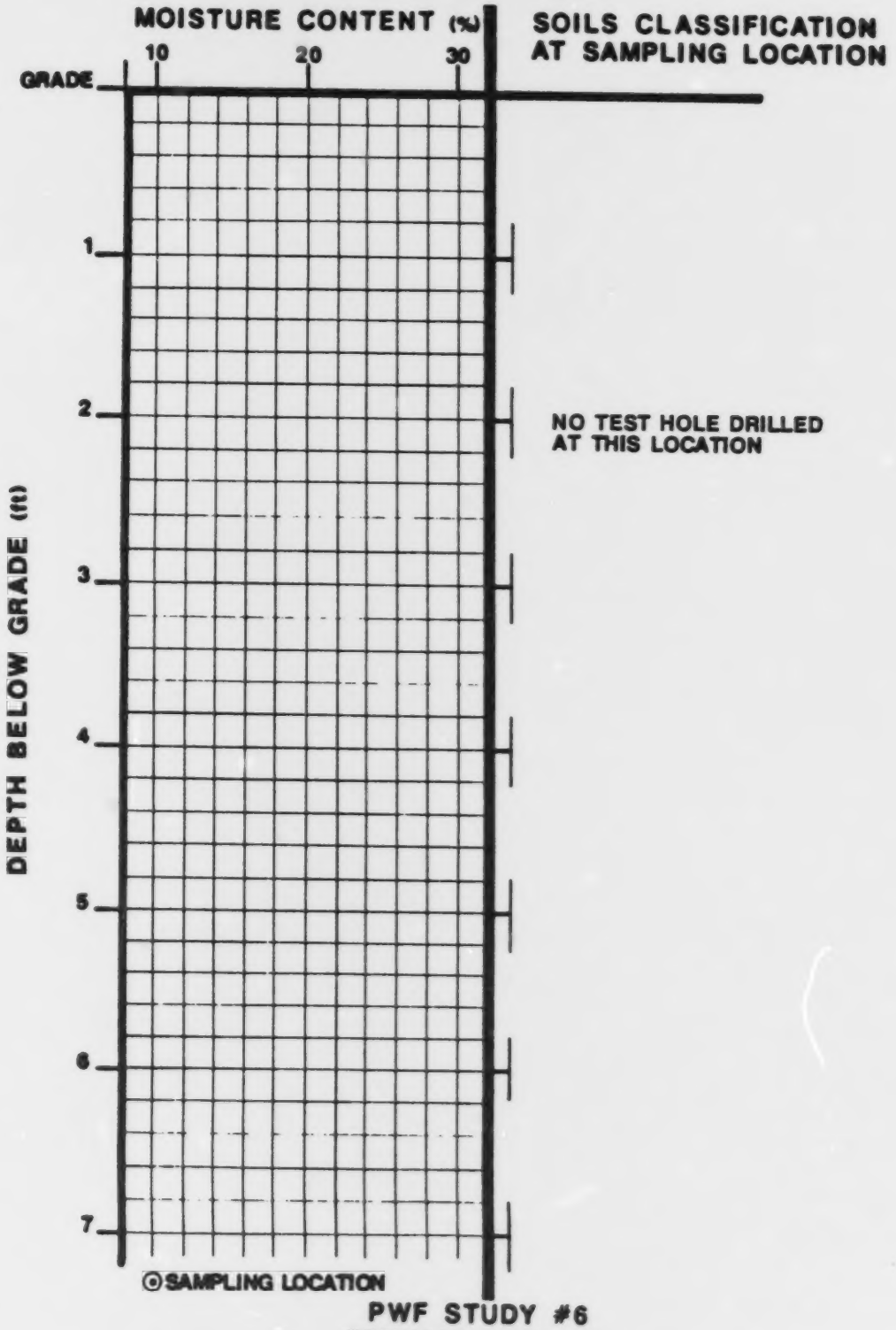

PWF STUDY #4
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



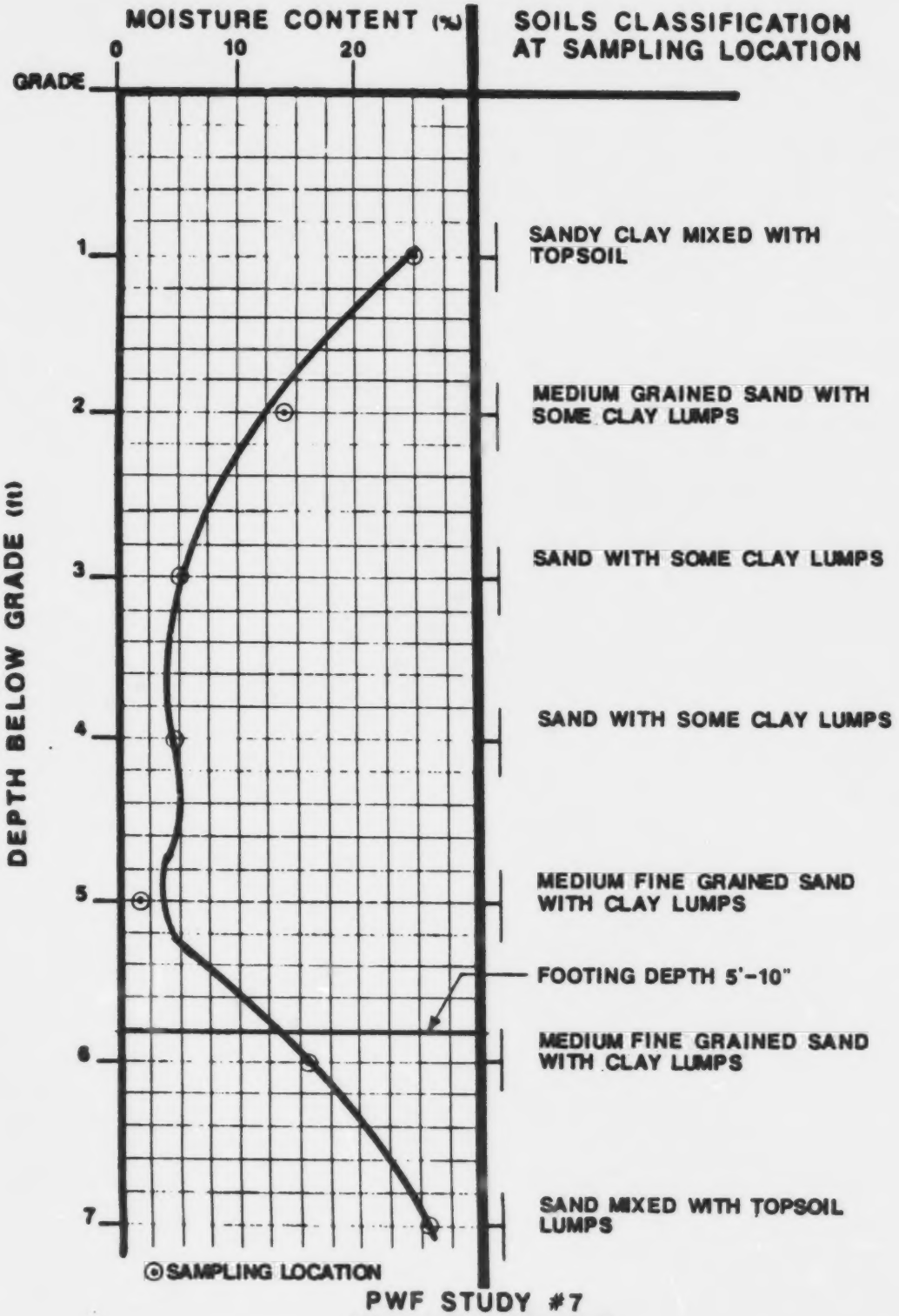

PWF STUDY #5
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



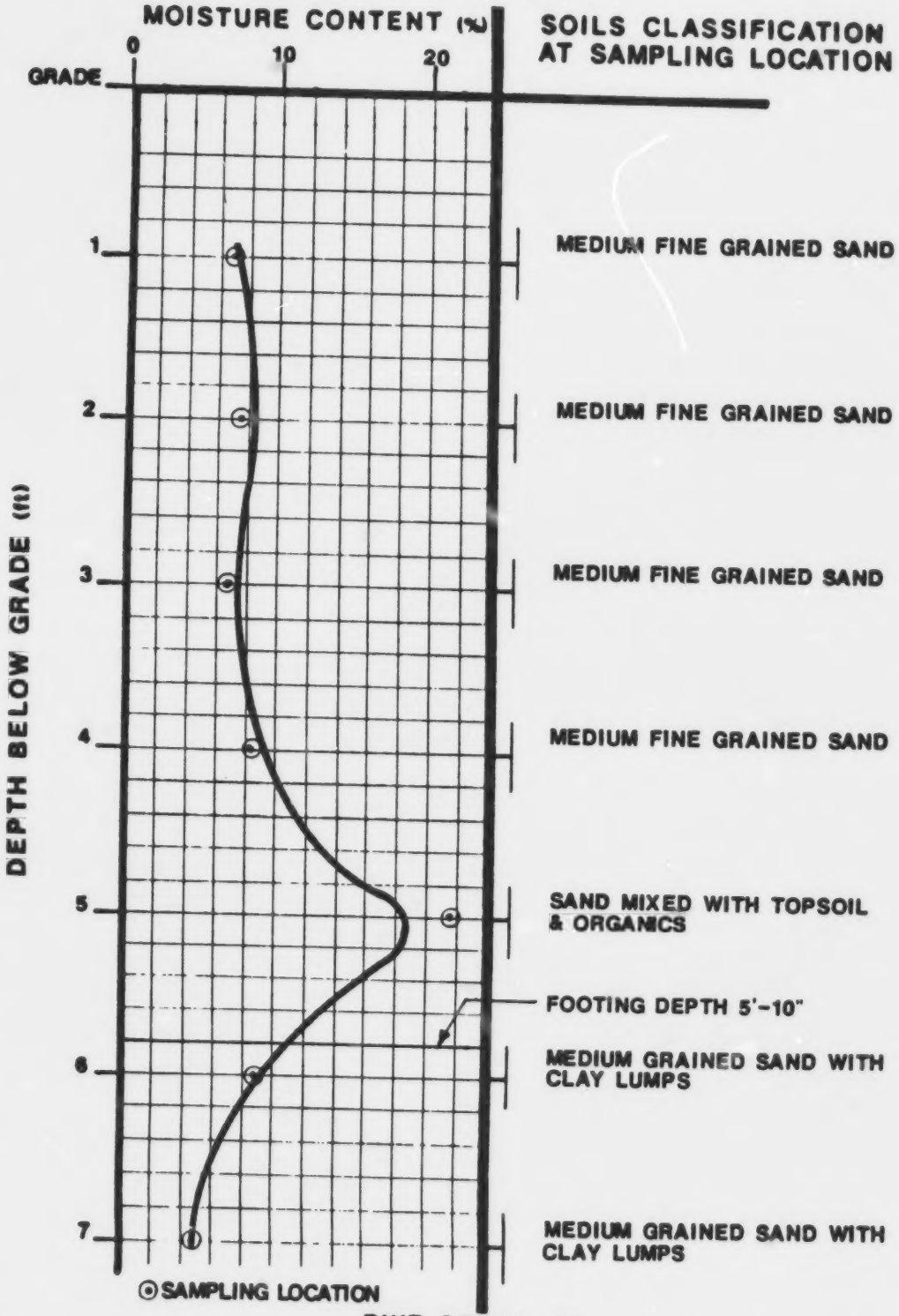

PWF STUDY #6
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



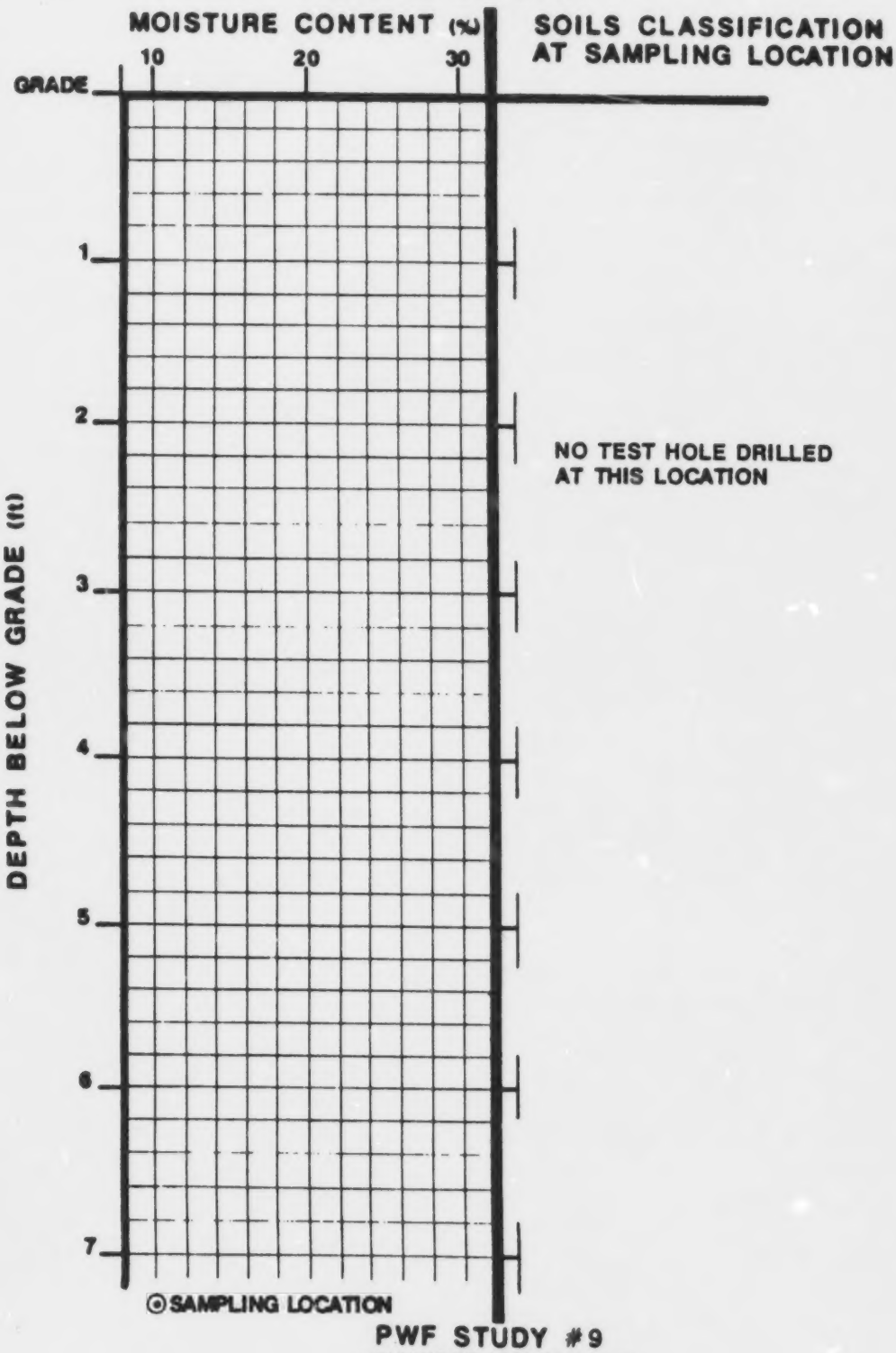

PWF STUDY #7
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



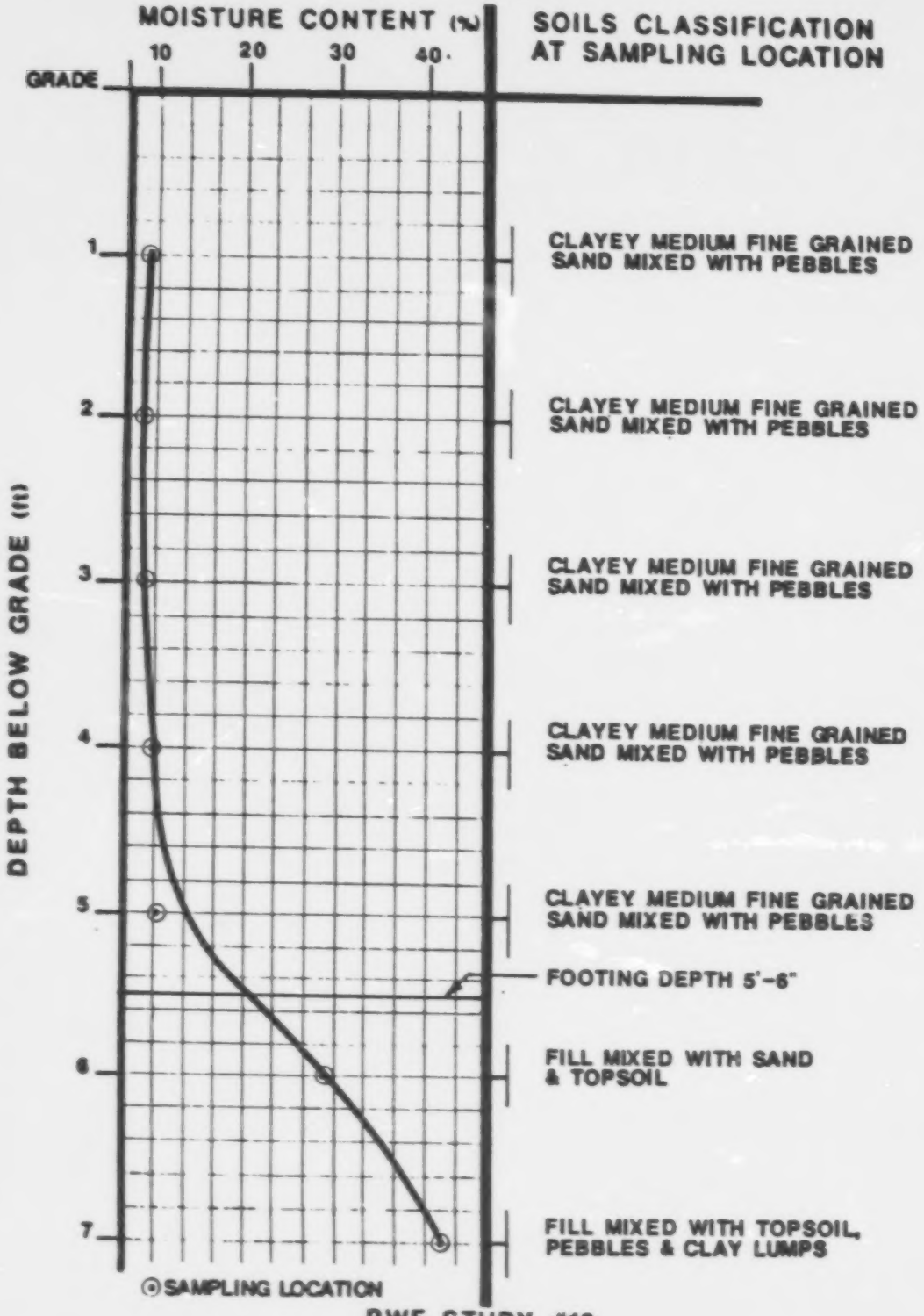

PWF STUDY #8
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #9
DRAINAGE IS NEGATIVE

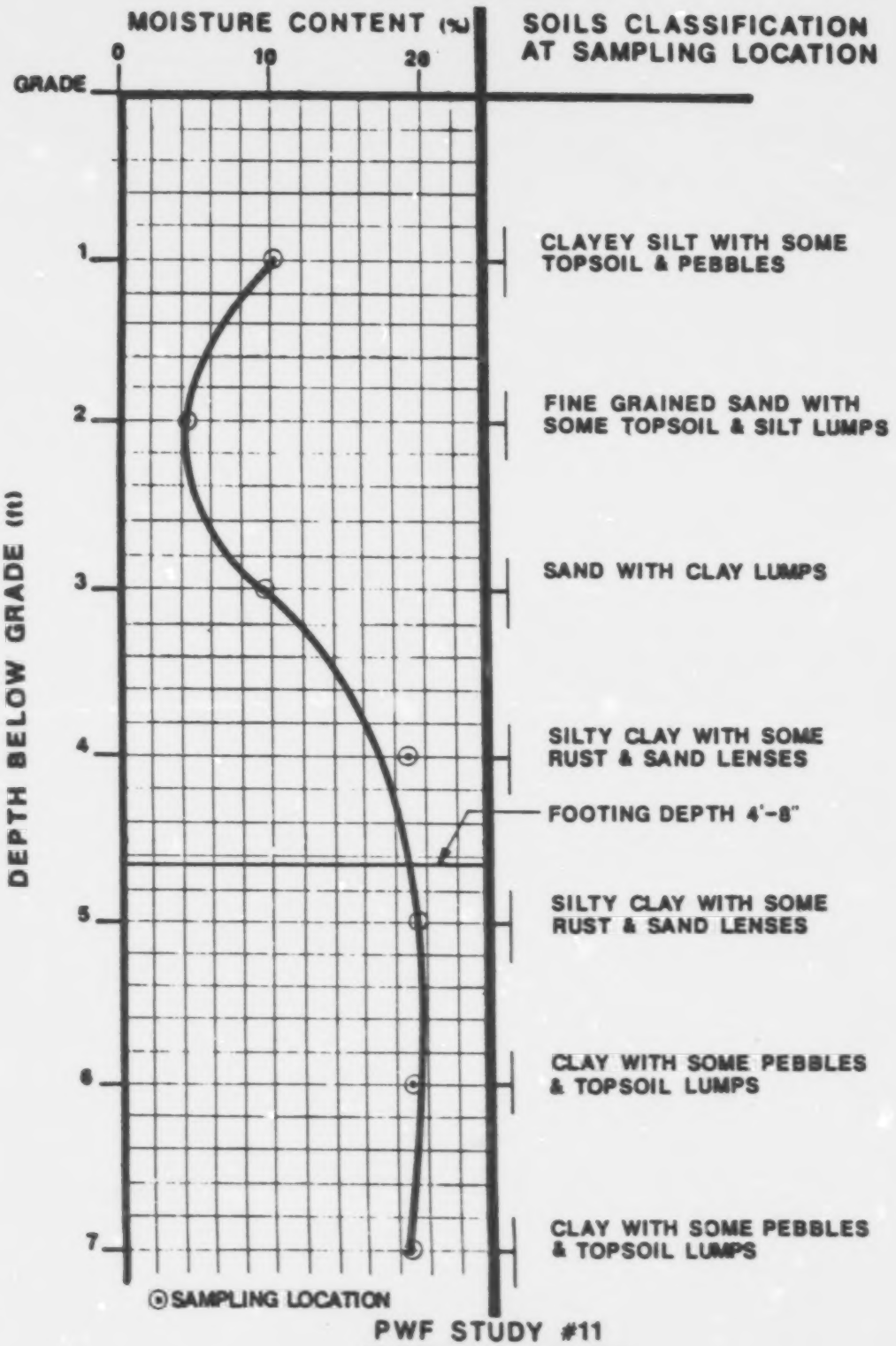
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




**PWF STUDY #10**

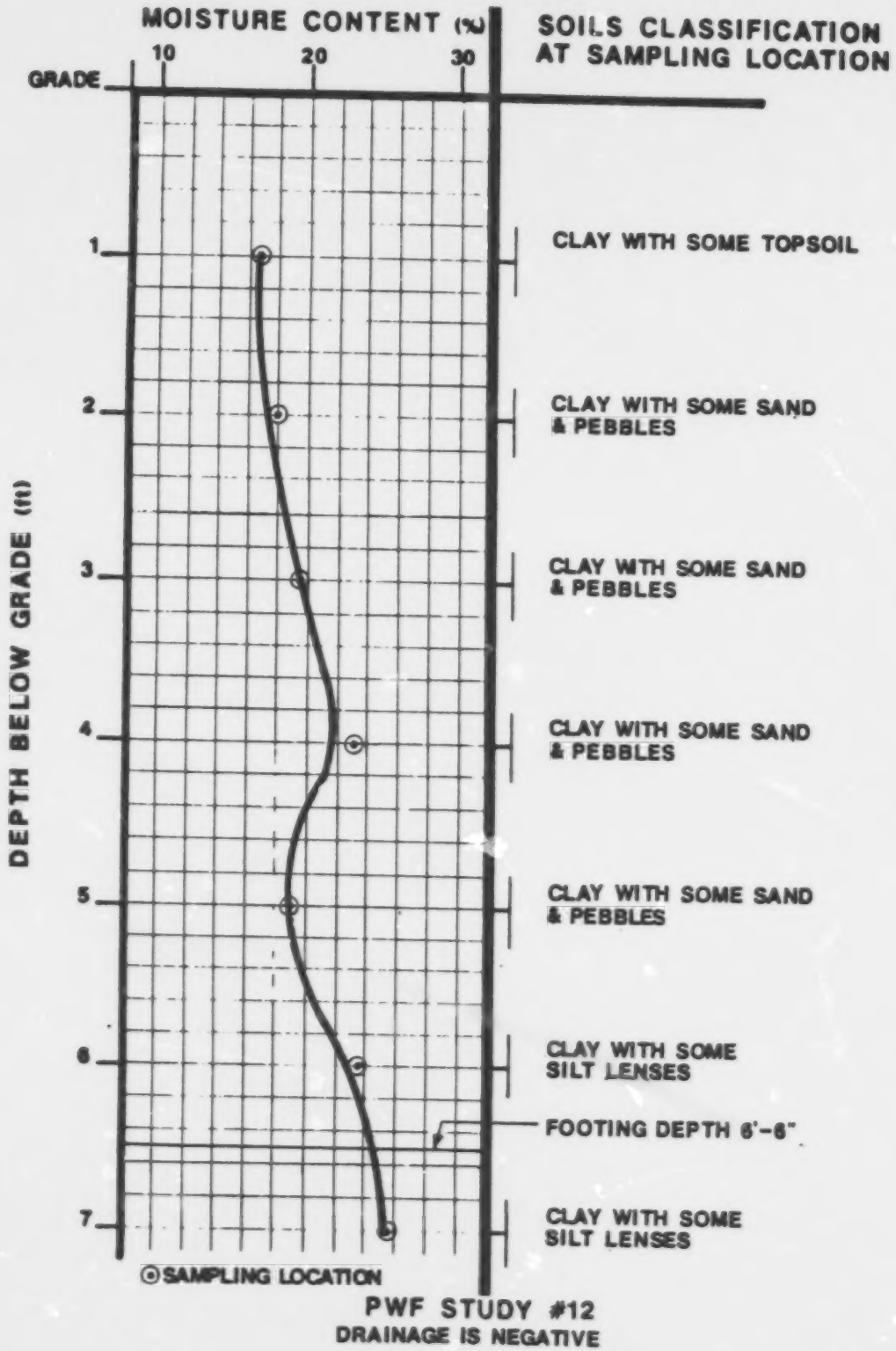
**DRAINAGE IS NEGATIVE**

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



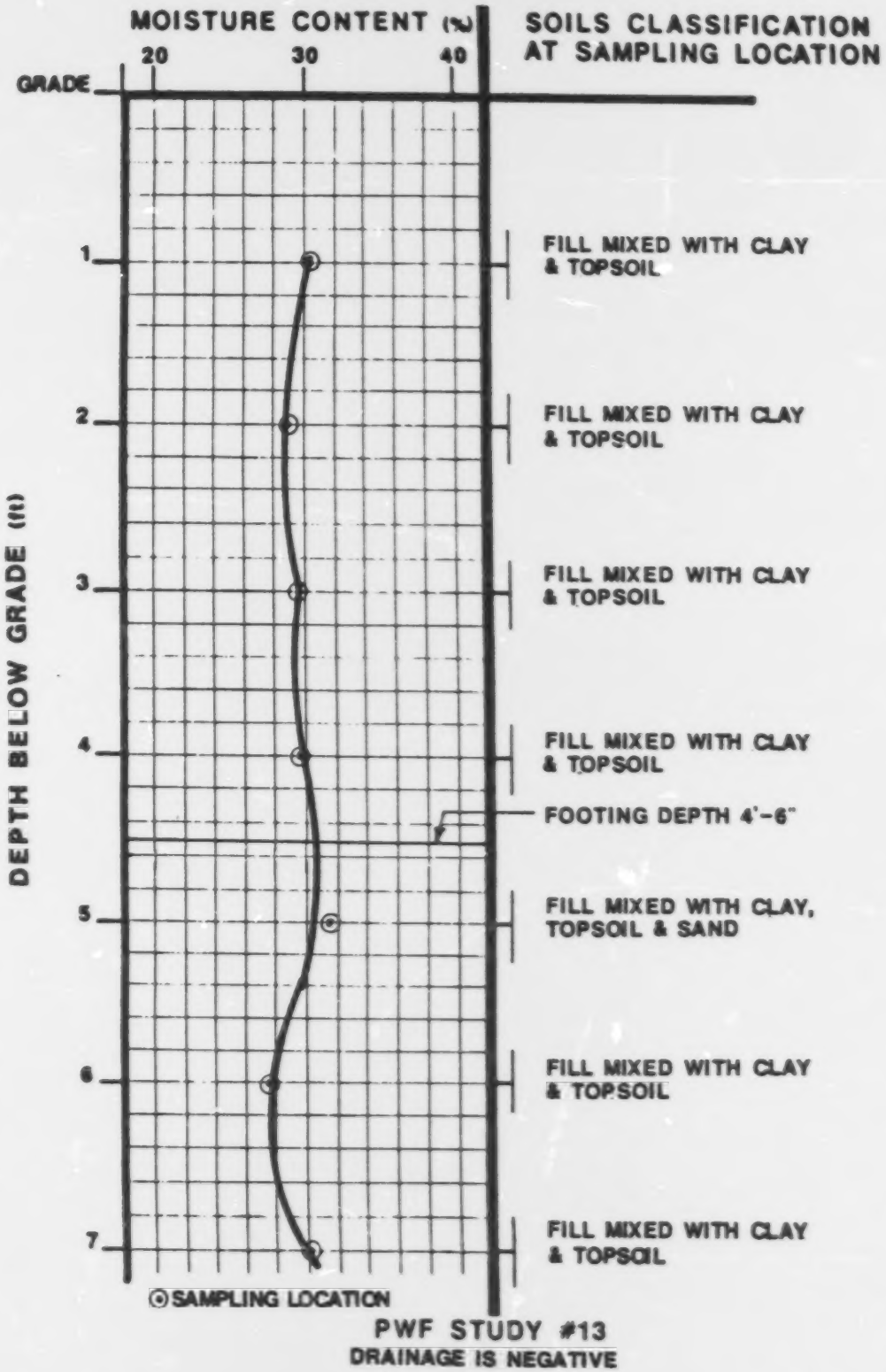

PWF STUDY #11
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #12
DRAINAGE IS NEGATIVE

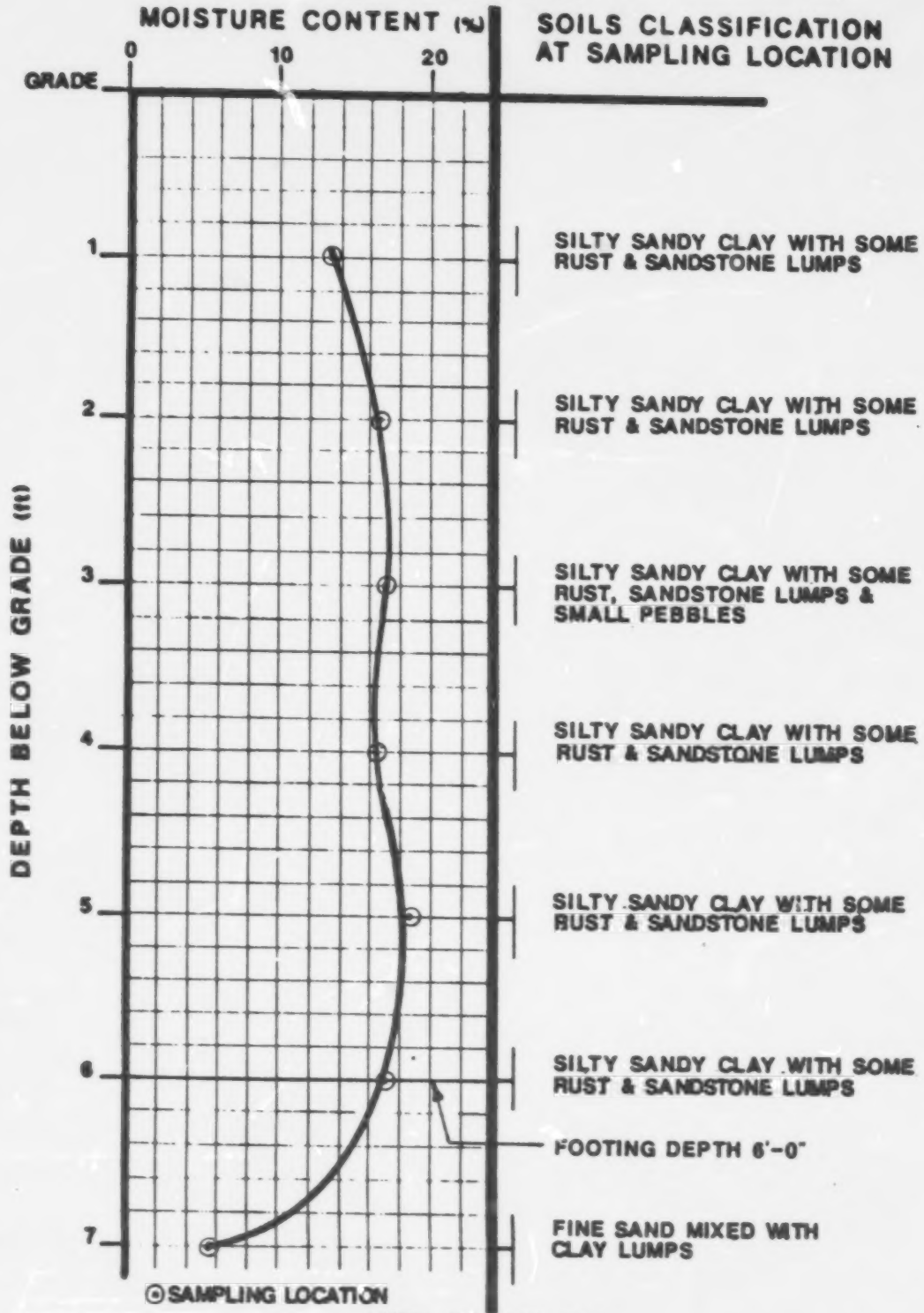
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #13

DRAINAGE IS NEGATIVE

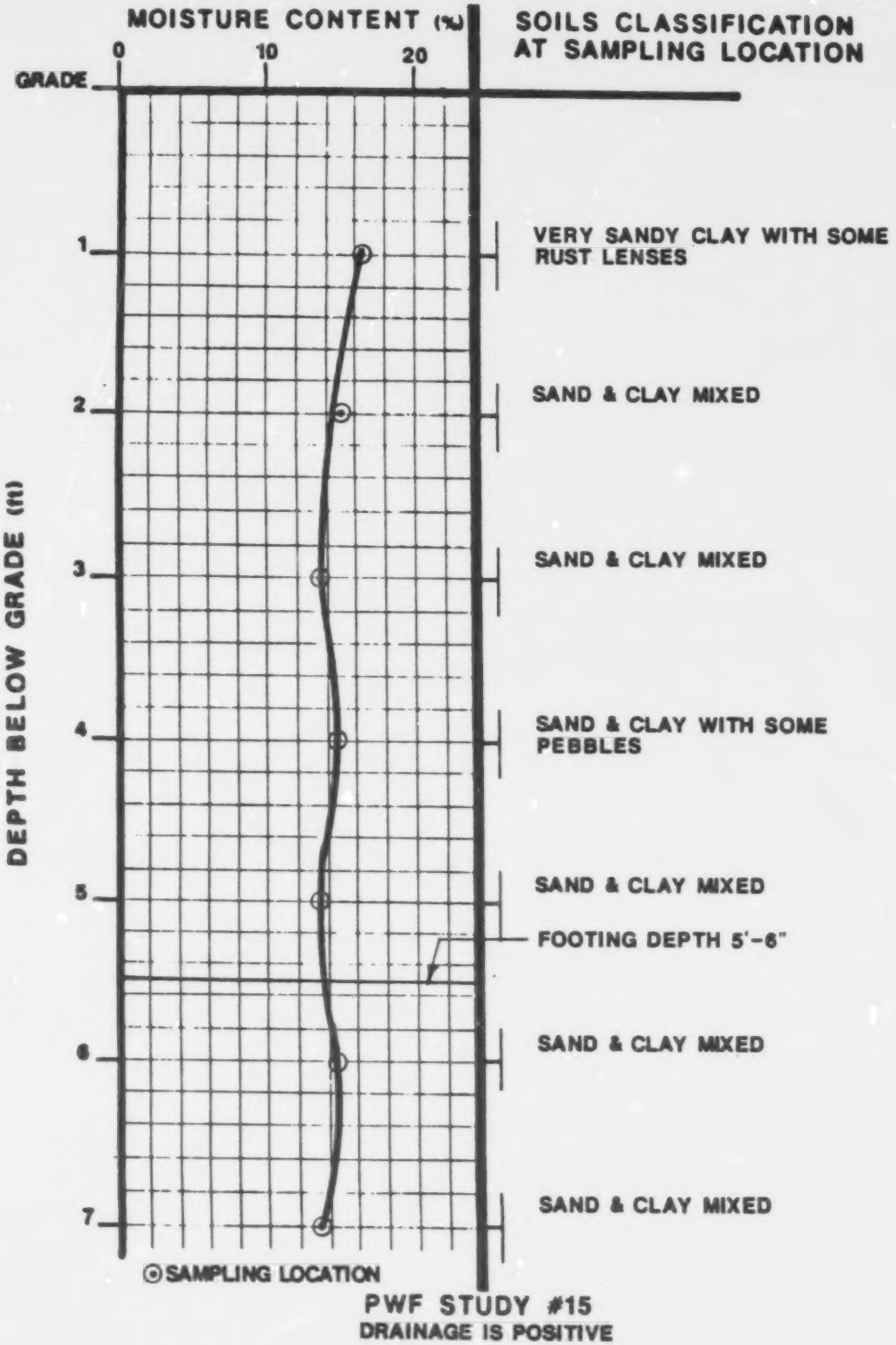
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #14

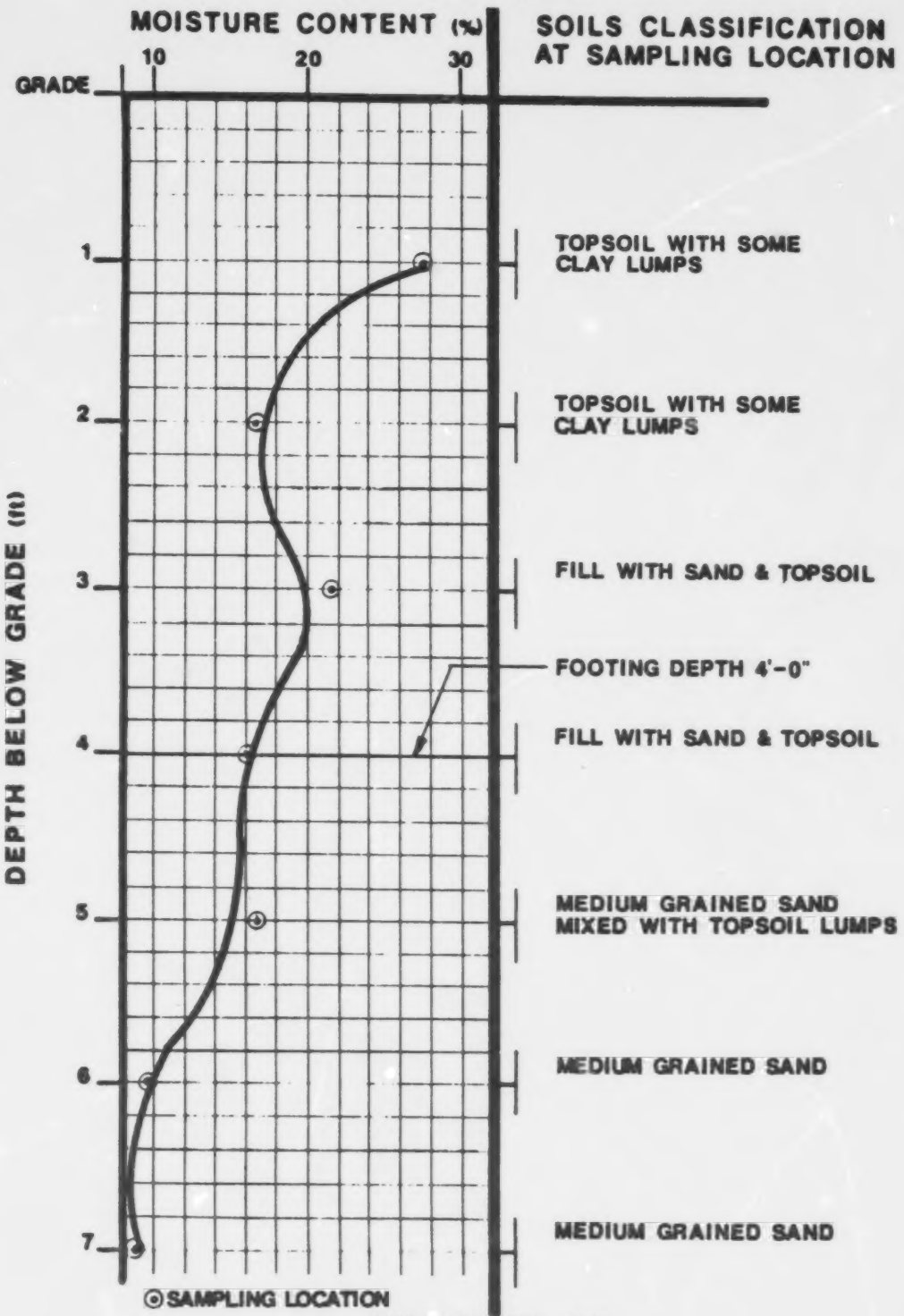
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #15
DRAINAGE IS POSITIVE

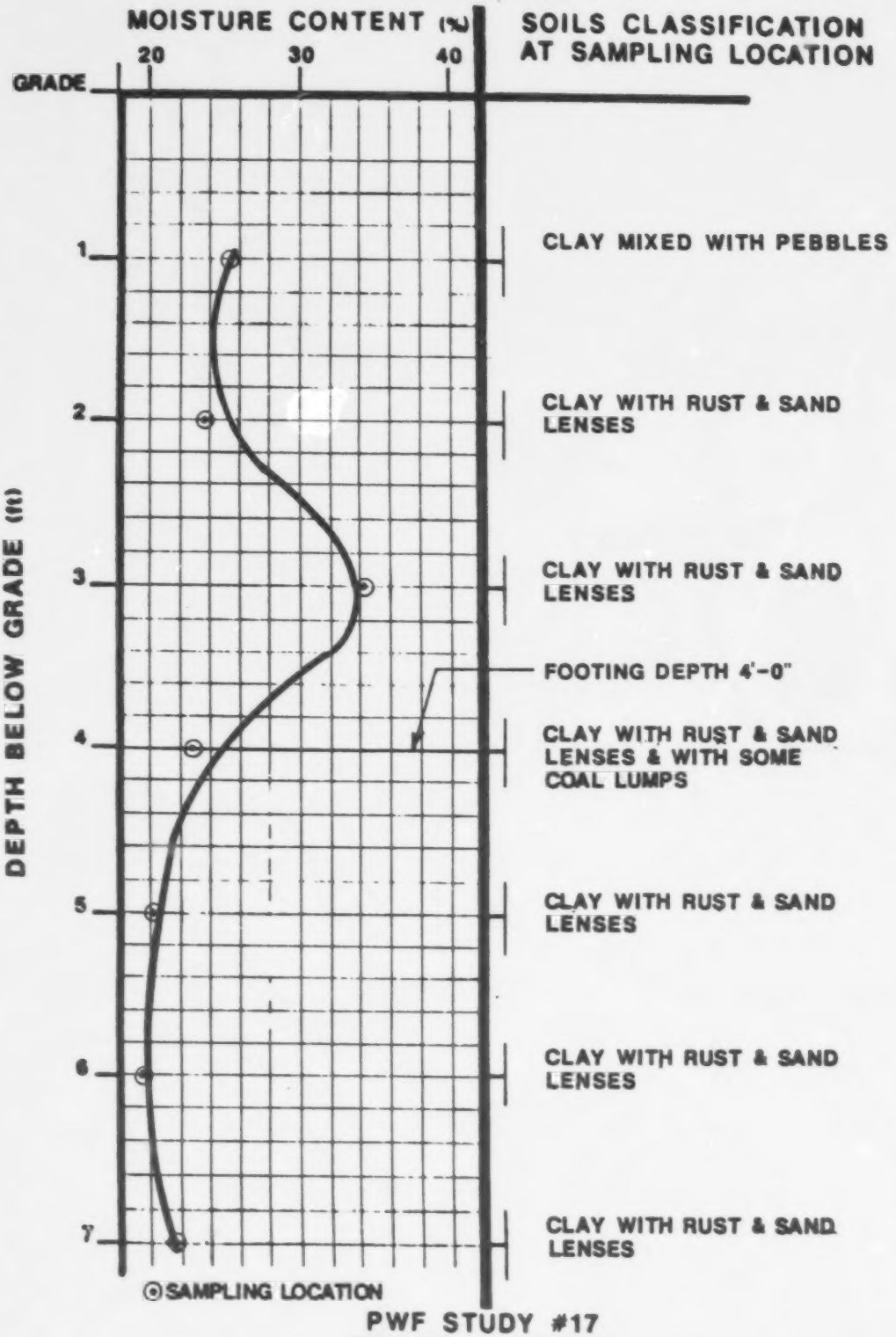
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF VS DEPTH OF SOIL




PWF STUDY #16

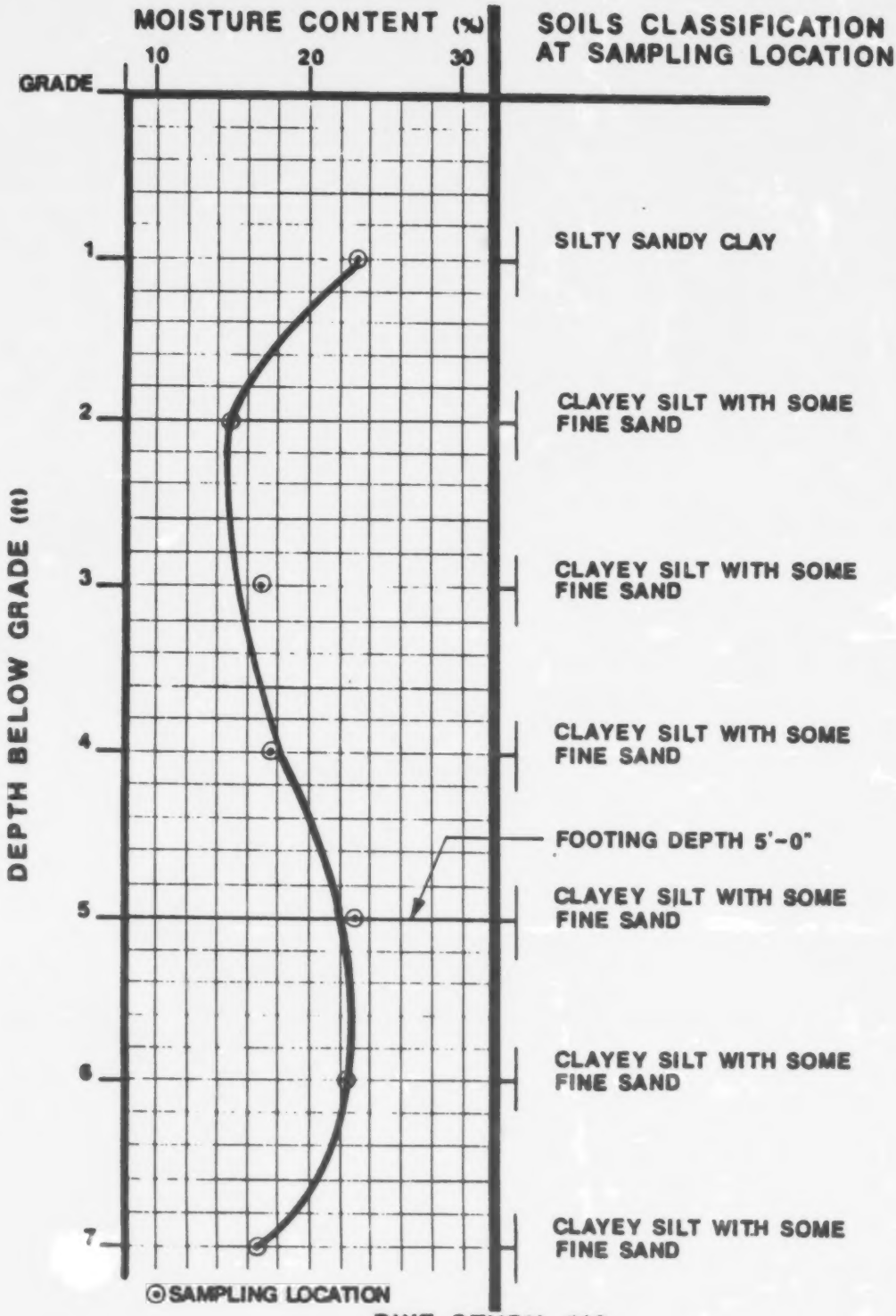
DRAINAGE IS POSITIVE

## MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
## DEPTH OF SOIL



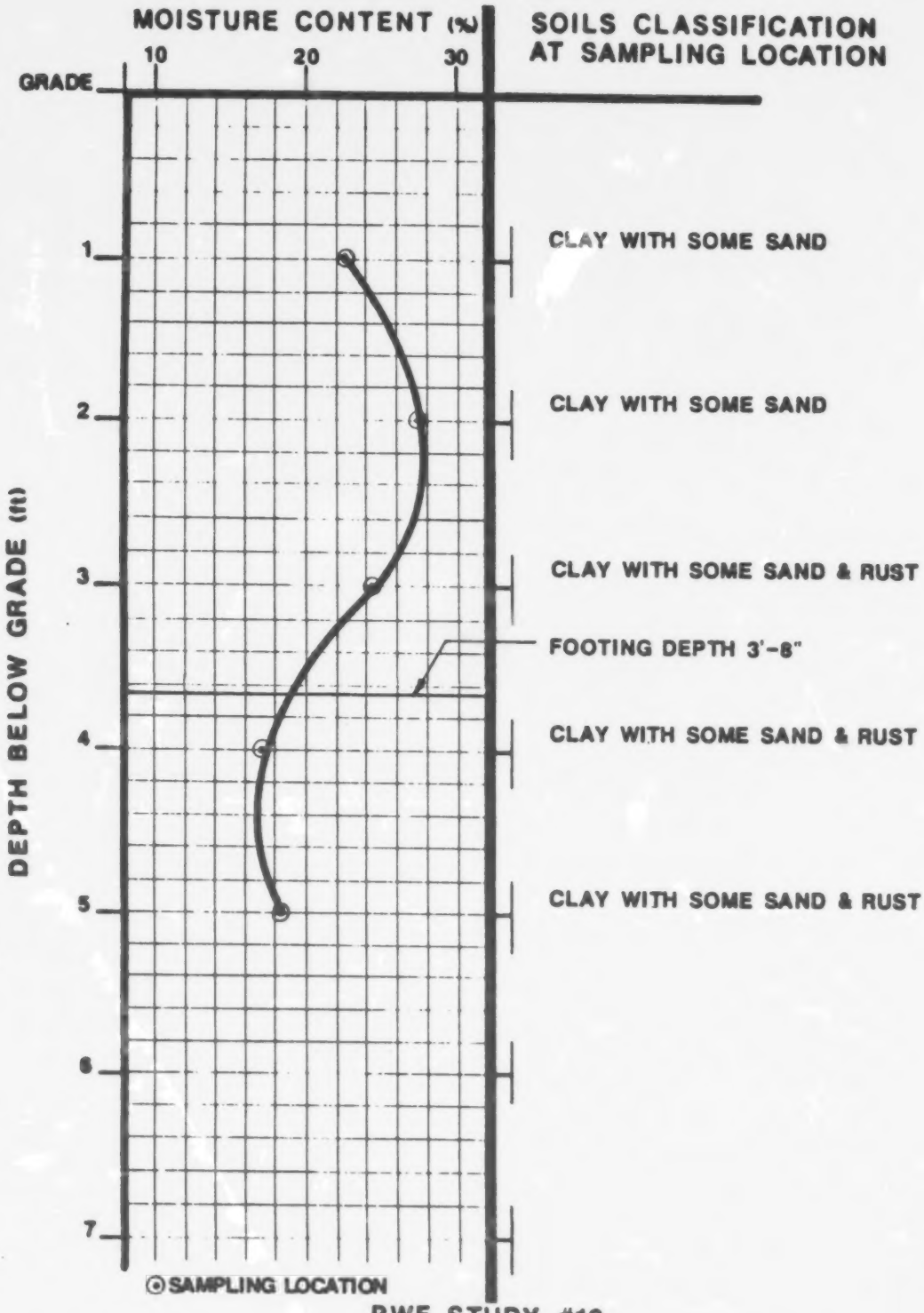

PWF STUDY #17
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



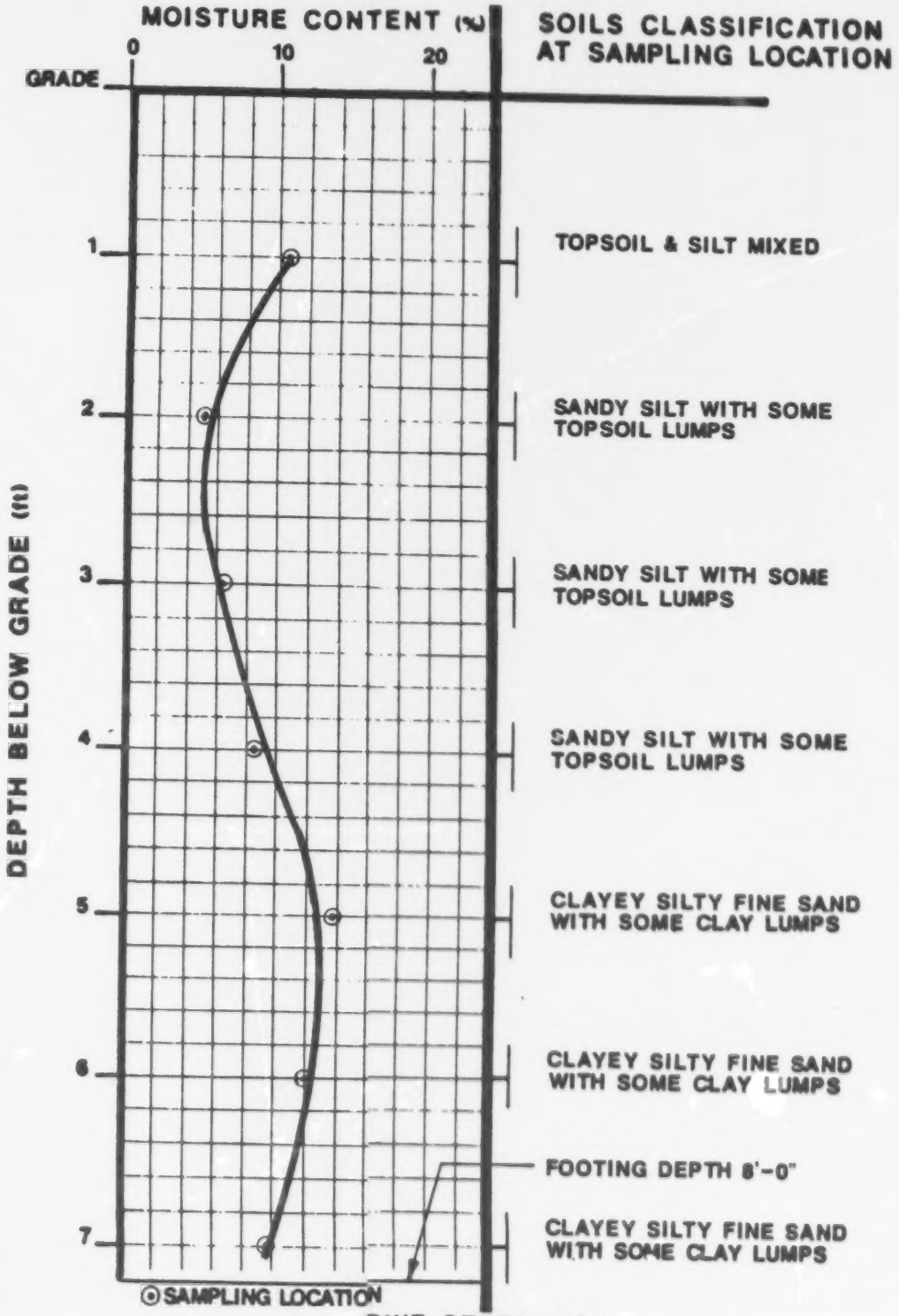

PWF STUDY #18
DRAINAGE IS POSITIVE

## MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
## VS
## DEPTH OF SOIL




PWF STUDY #19
DRAINAGE IS POSITIVE

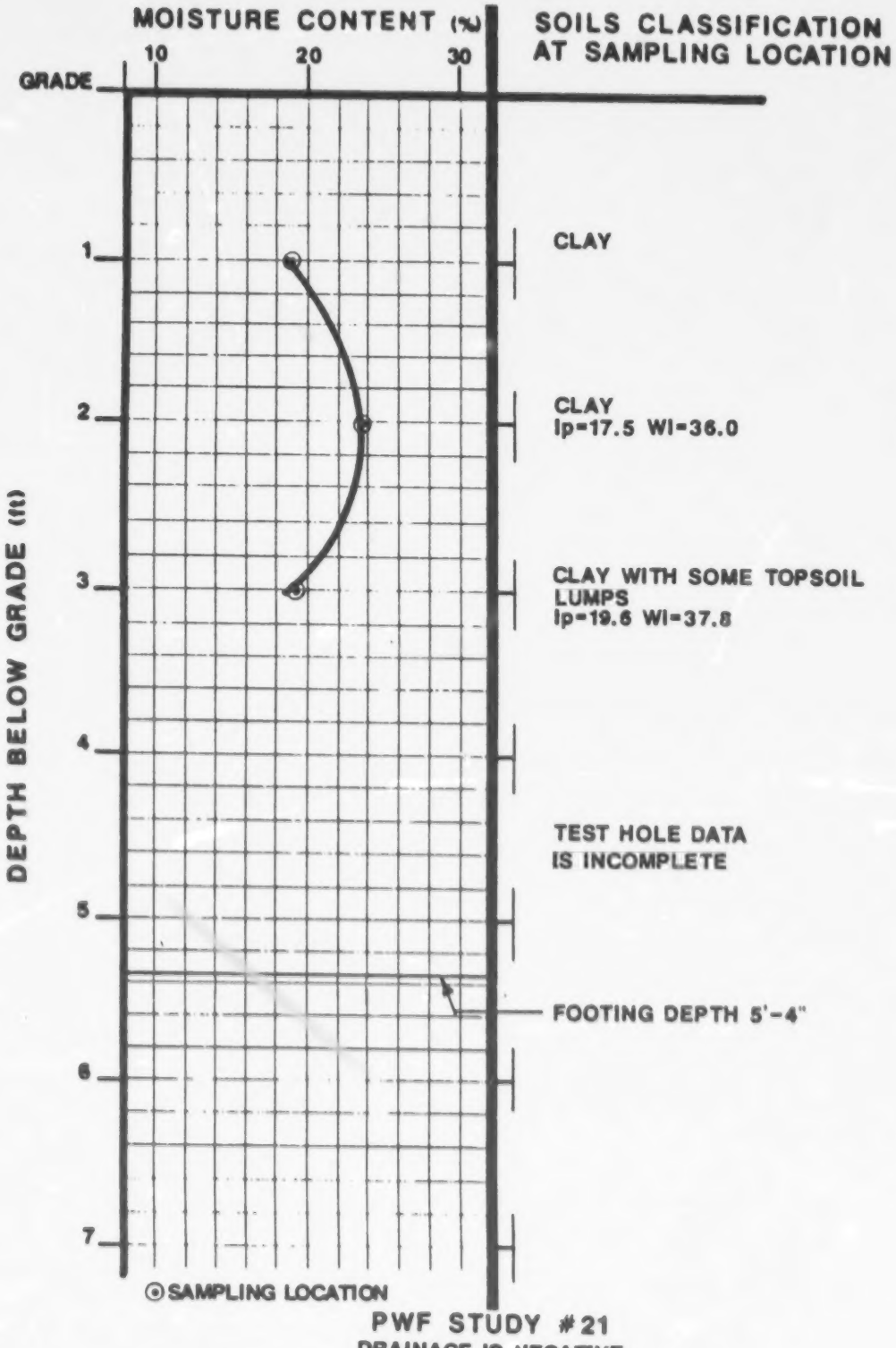
# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #20

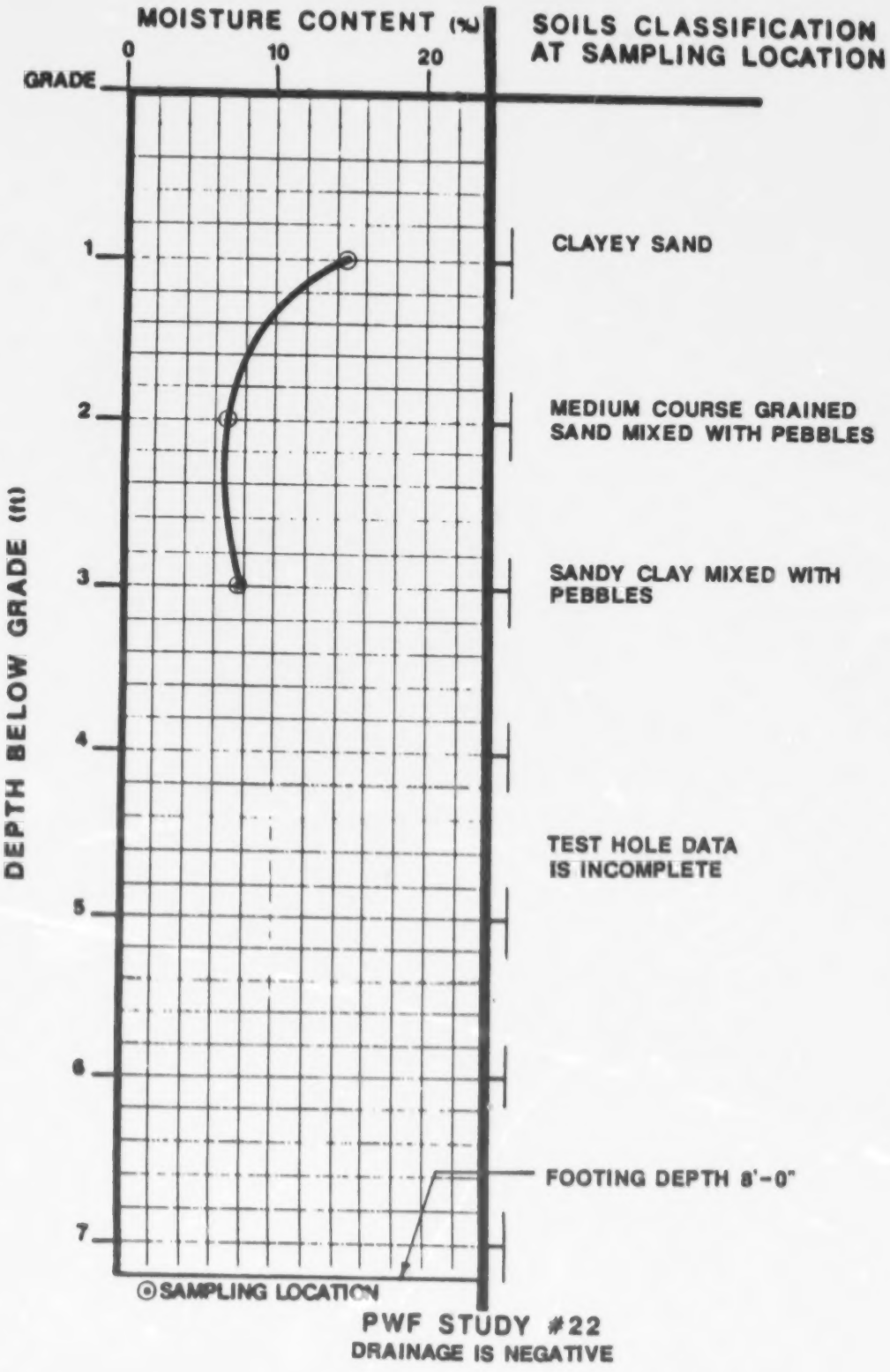
DRAINAGE IS POSITIVE

## MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
## DEPTH OF SOIL



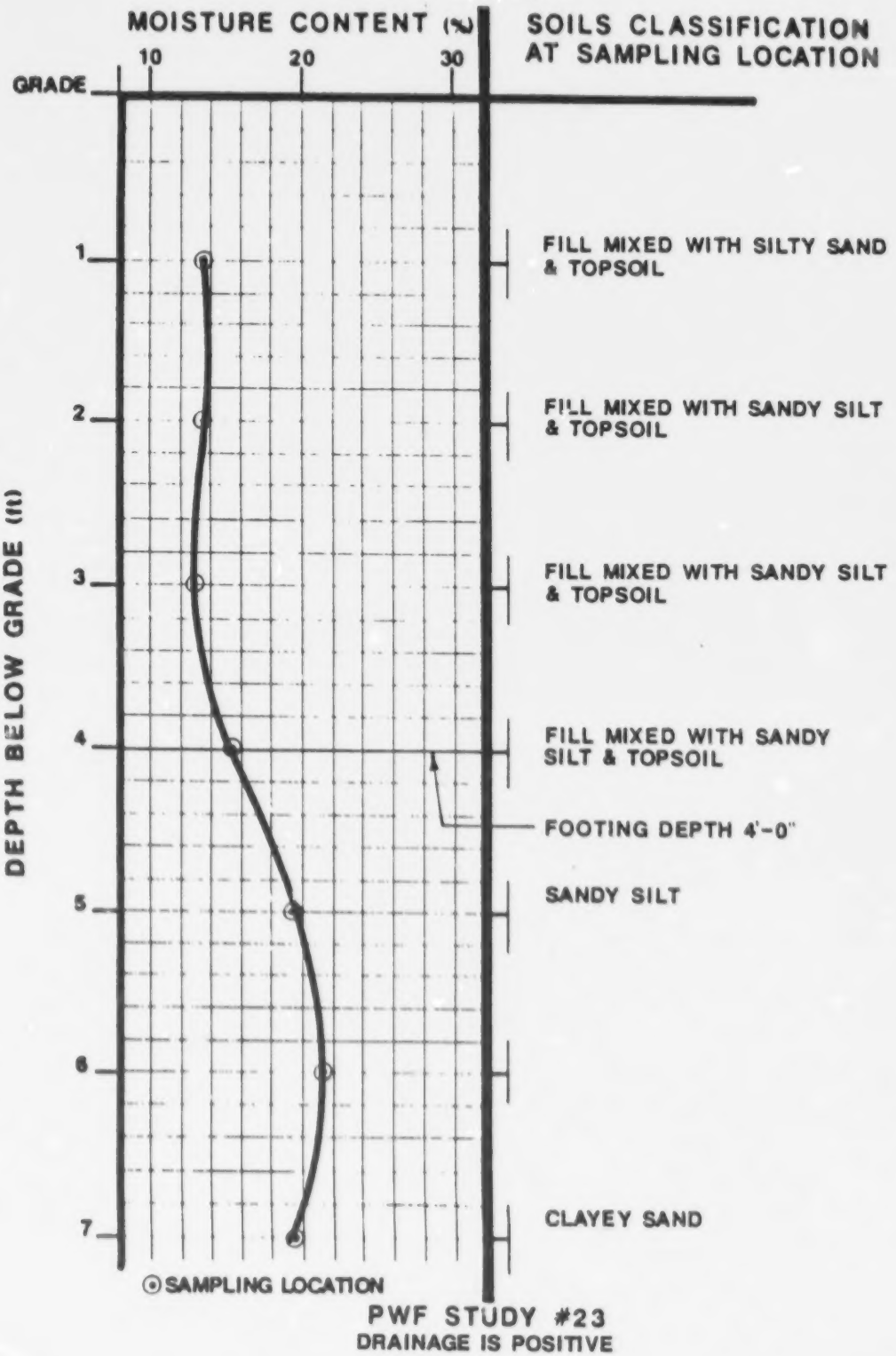

PWF STUDY #21
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



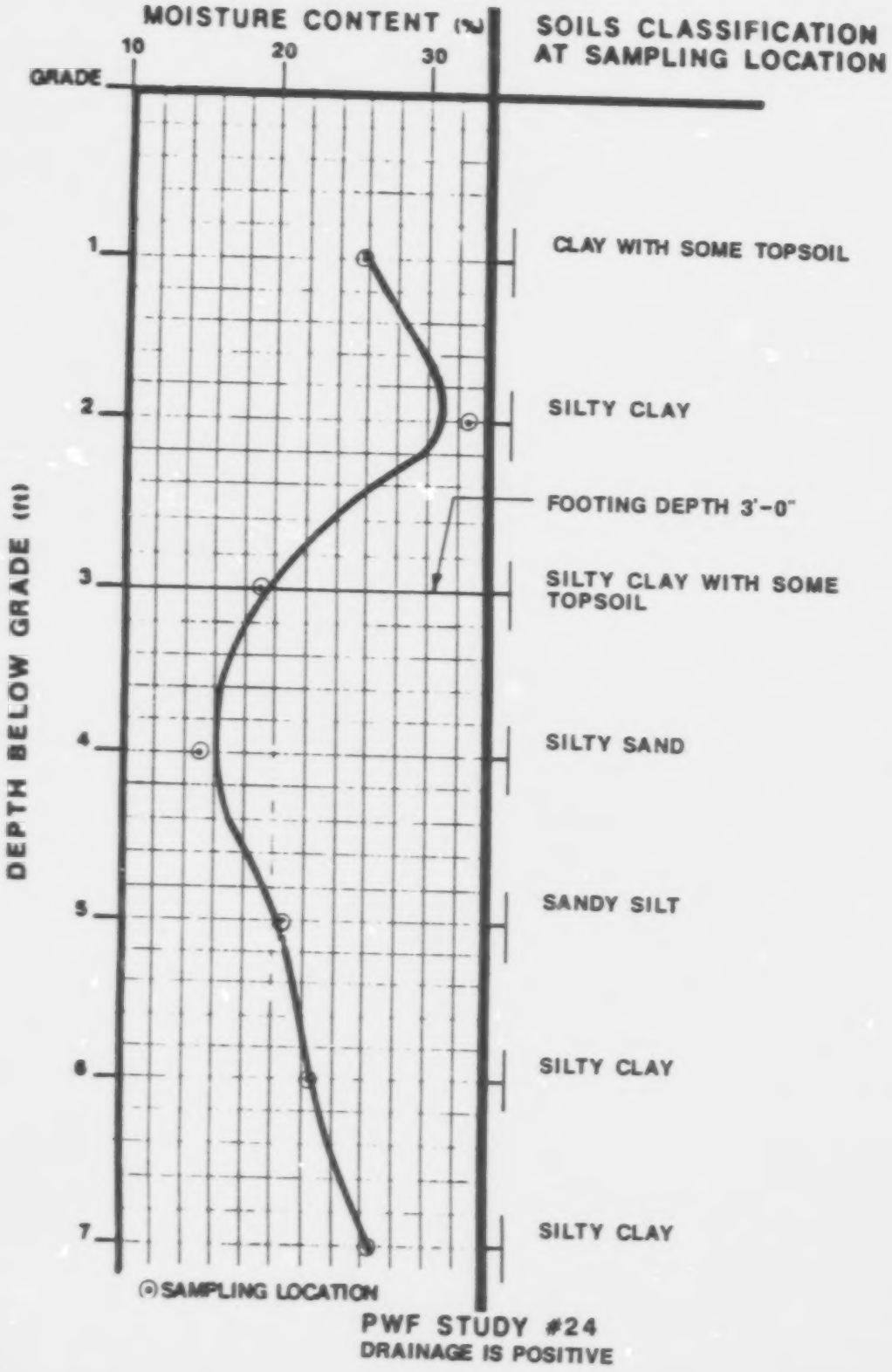

PWF STUDY #22
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



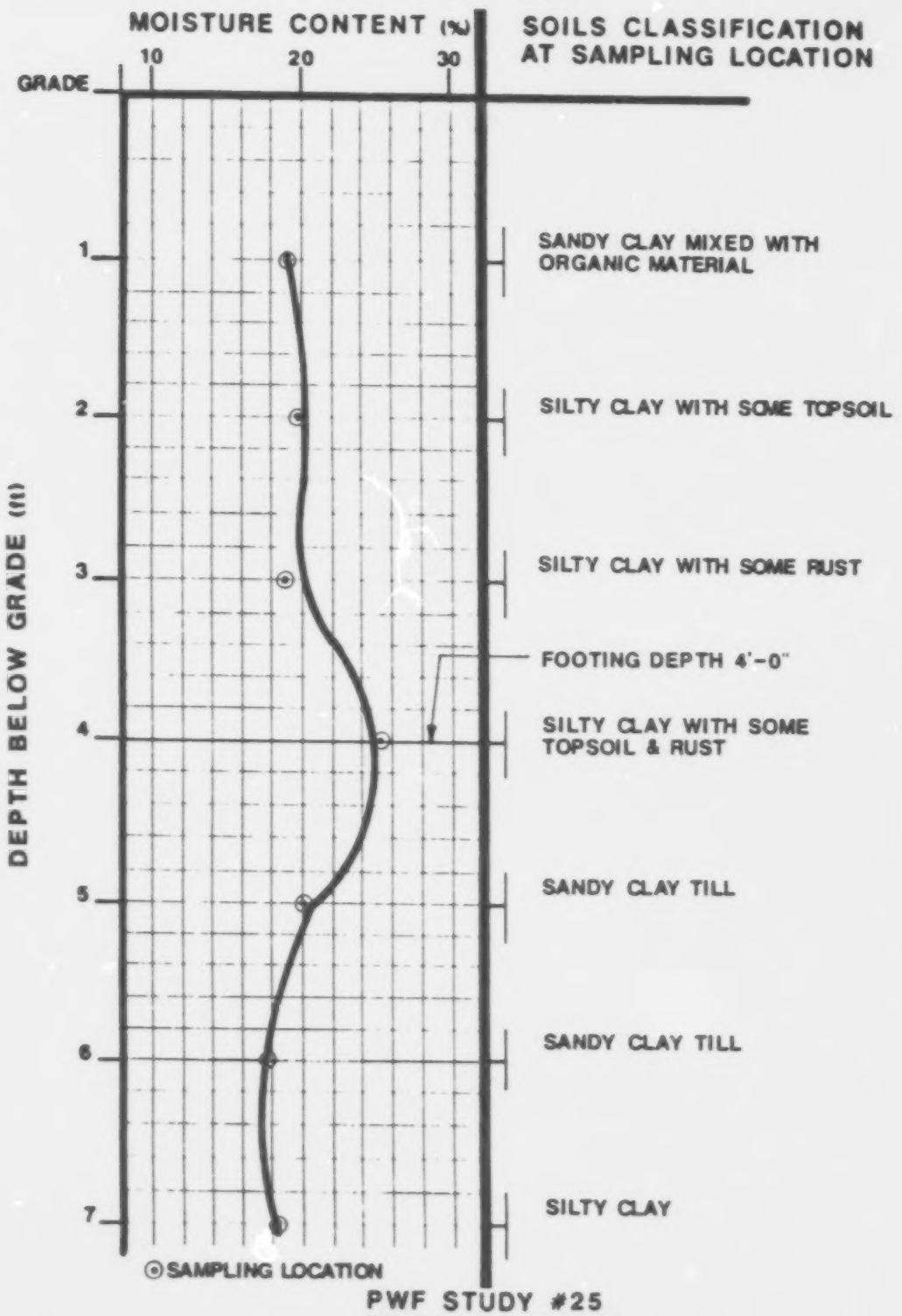

PWF STUDY #23
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



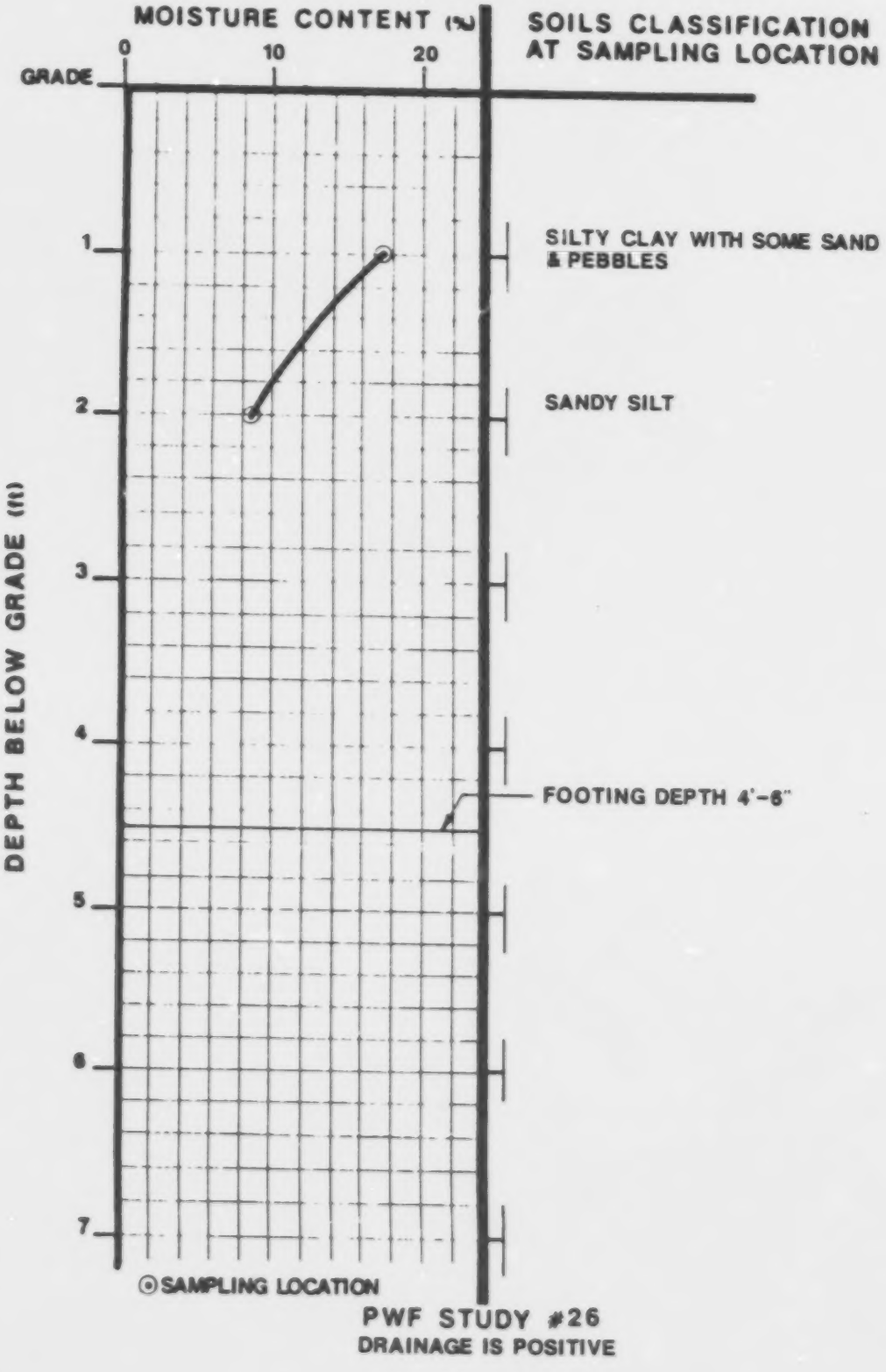

PWF STUDY #24
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



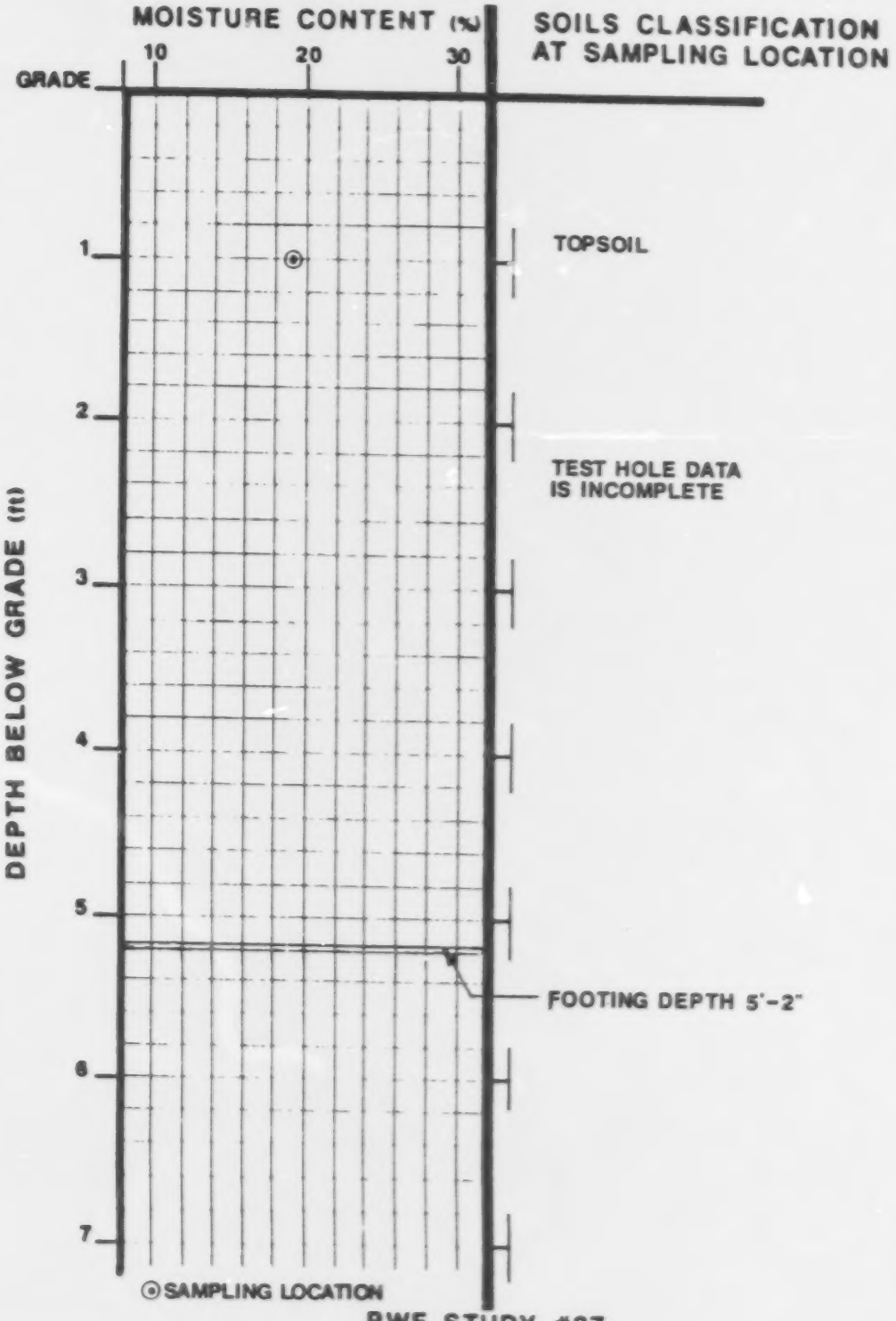

PWF STUDY #25
DRAINAGE IS POSITIVE

## MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
## VS
## DEPTH OF SOIL



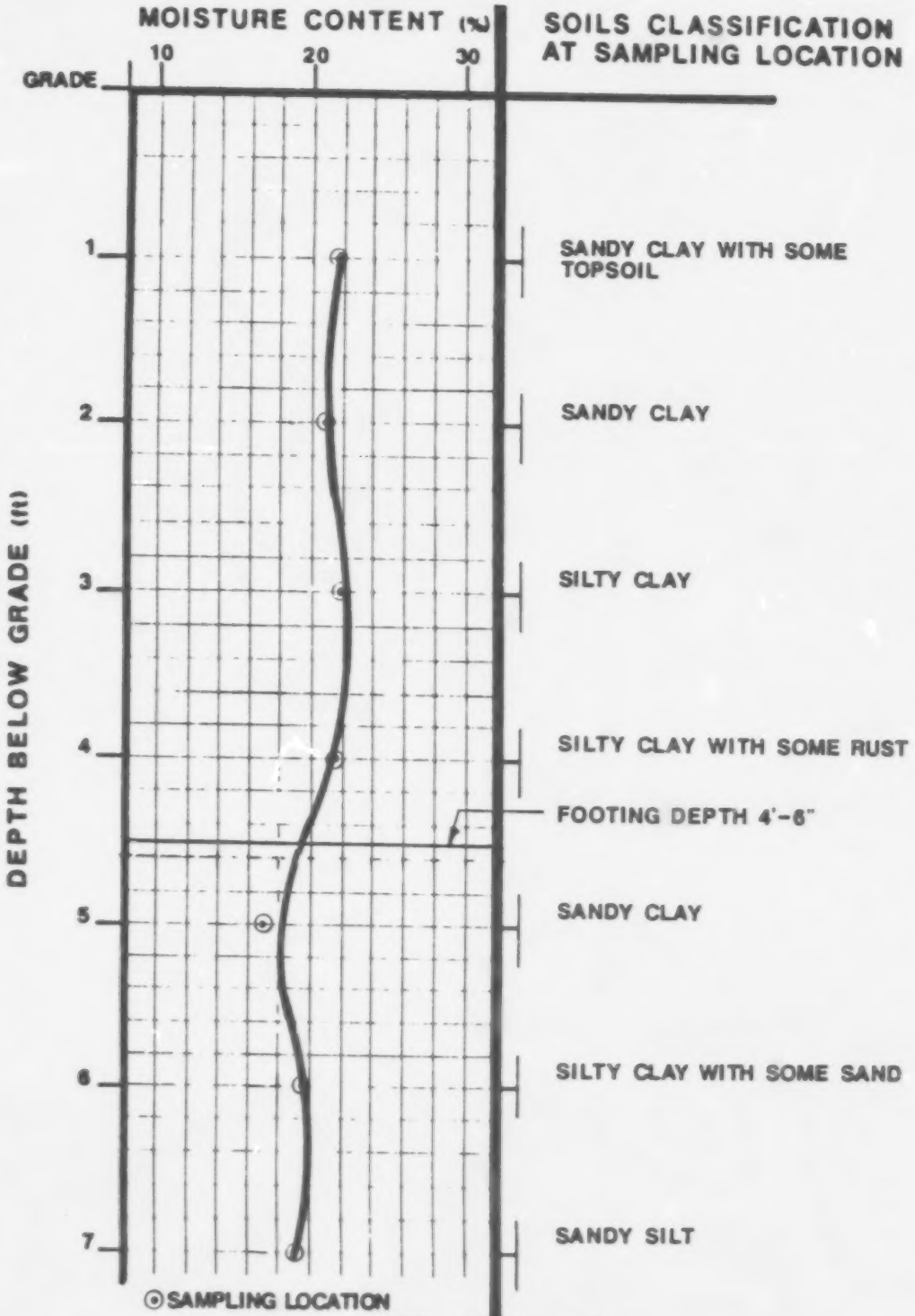

PWF STUDY #26
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



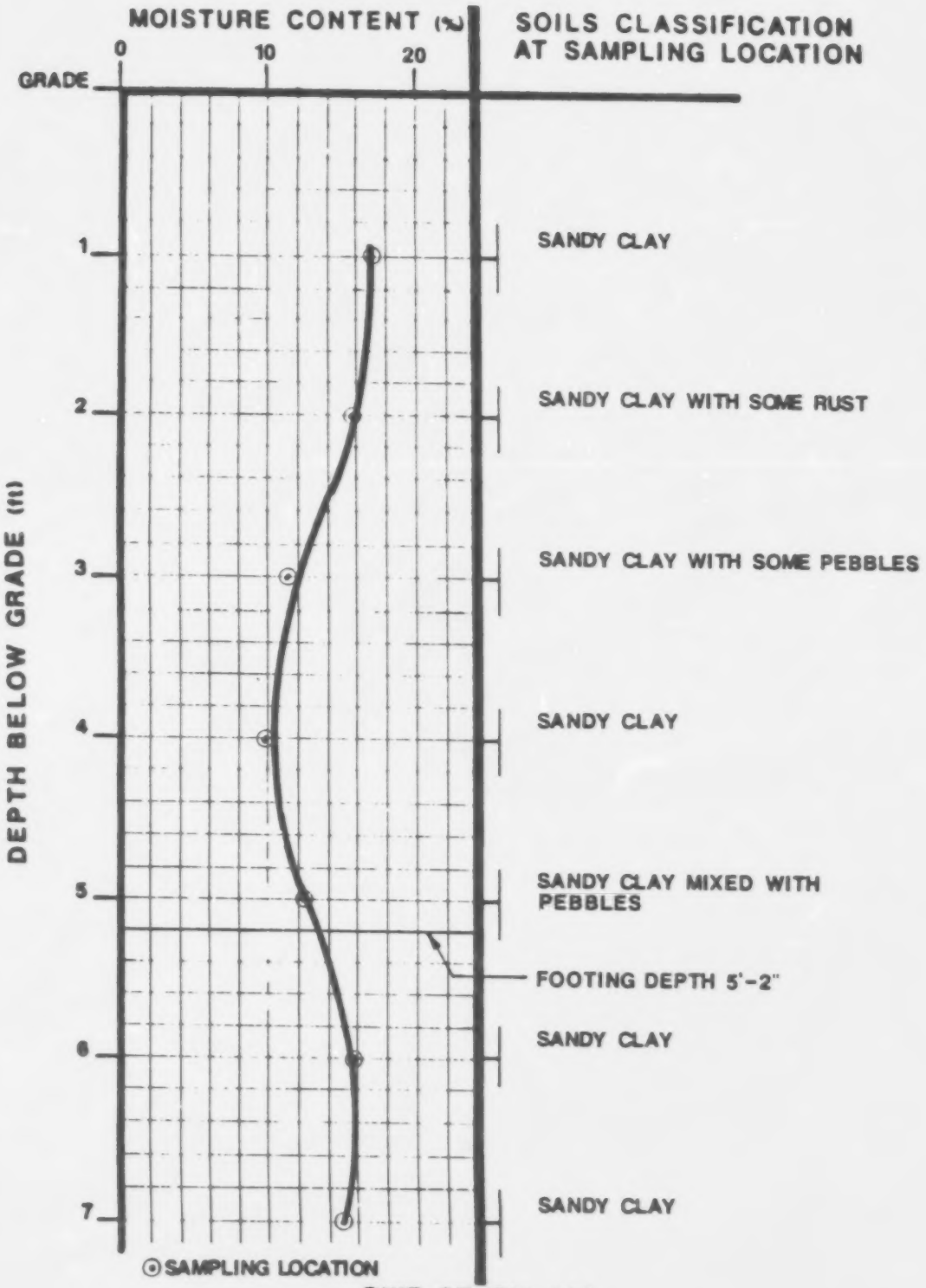

PWF STUDY #27
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



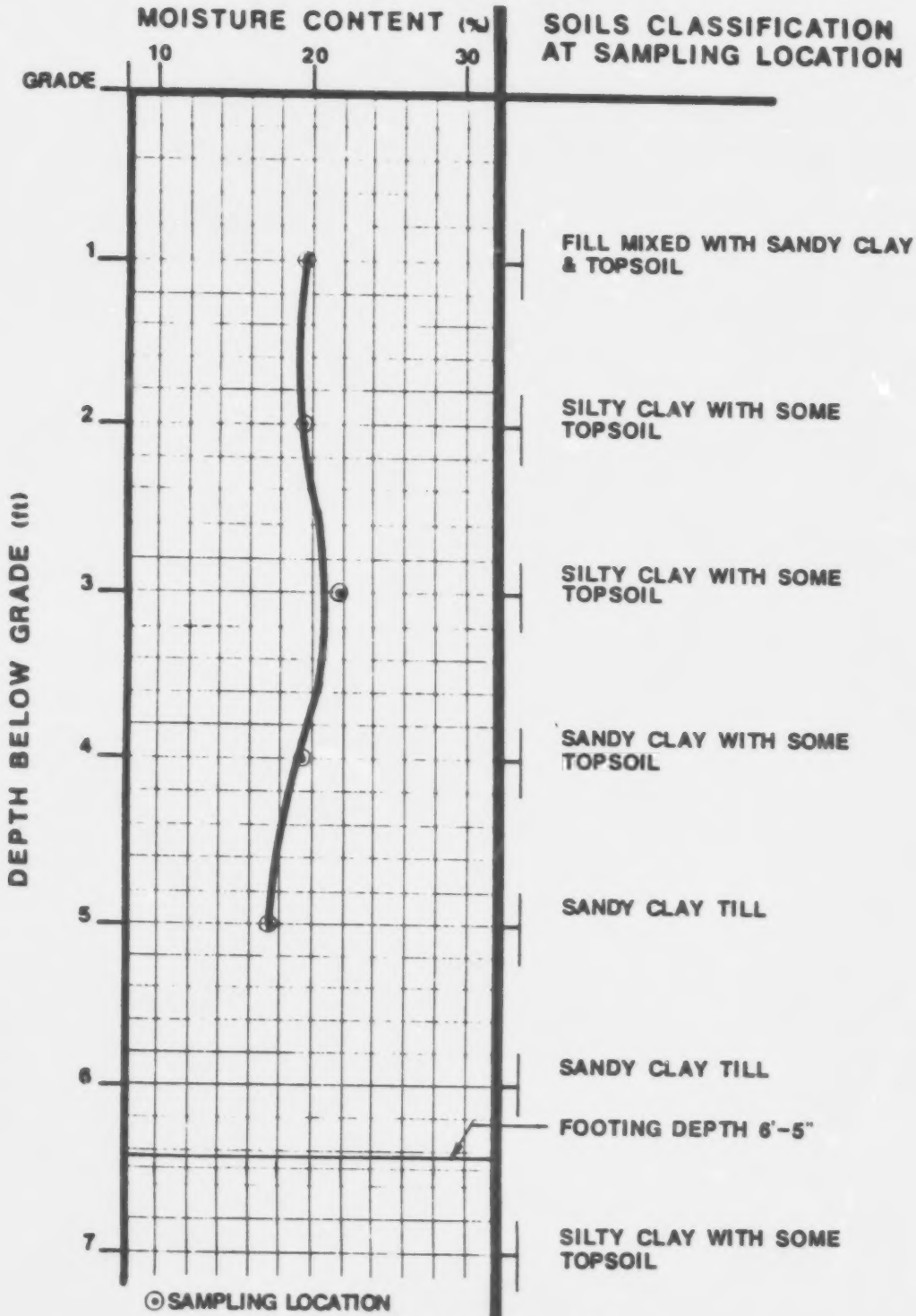

PWF STUDY #28
DRAINAGE IS NEGATIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



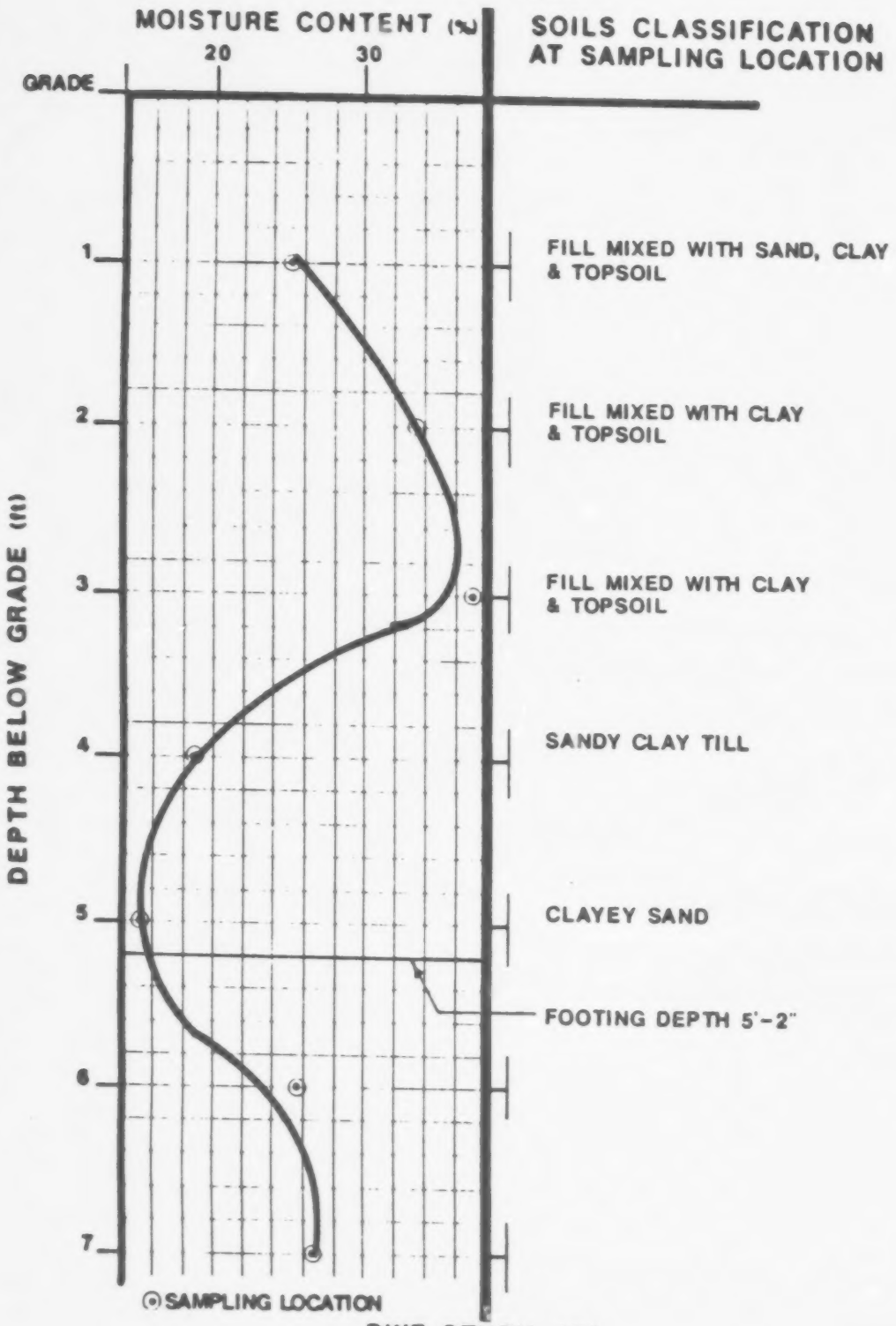

PWF STUDY #29
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL



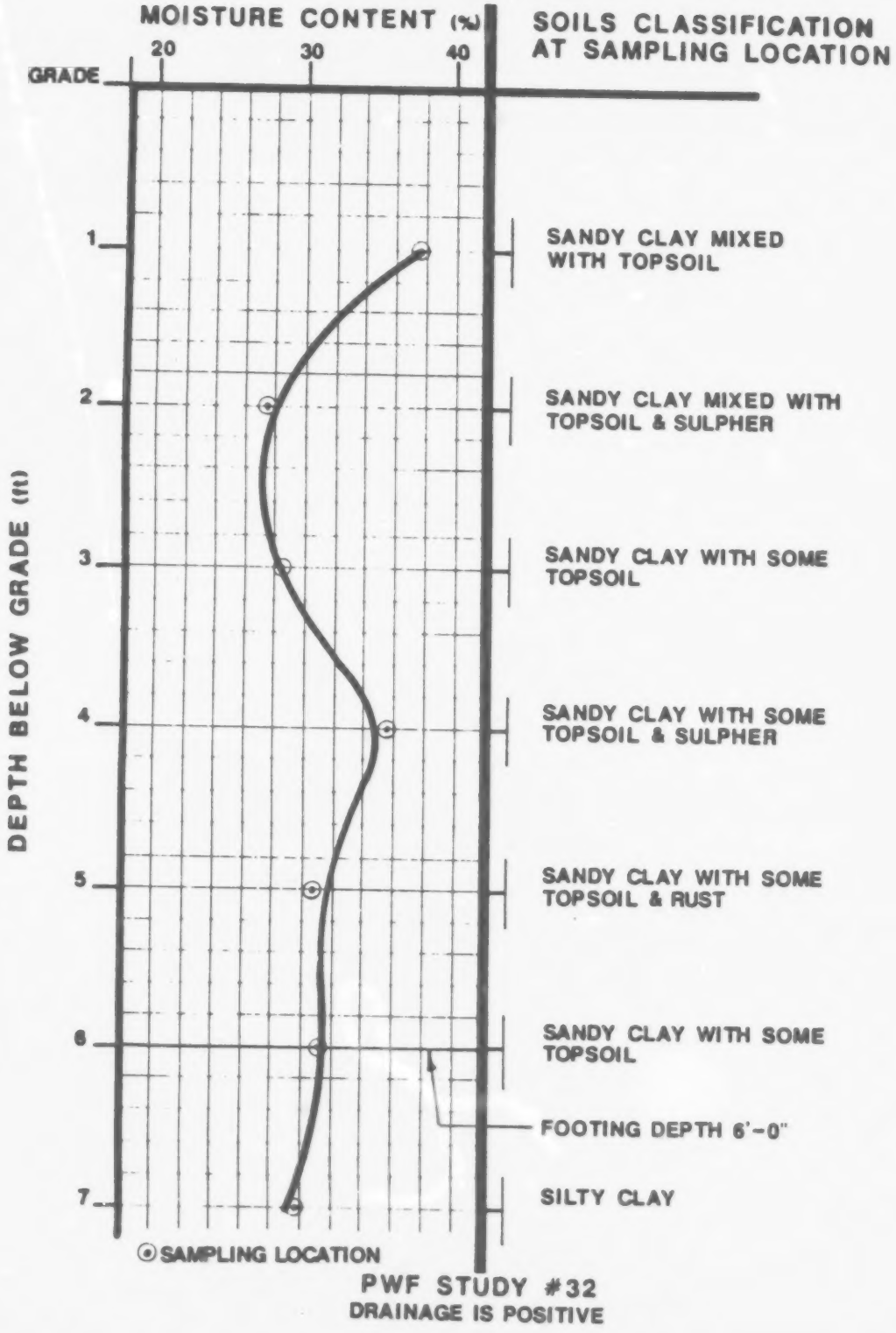

PWF STUDY #30
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #31
DRAINAGE IS POSITIVE

# MOISTURE CONTENT OF SOIL 3 FEET OUT FROM PWF
VS
# DEPTH OF SOIL




PWF STUDY #32
DRAINAGE IS POSITIVE

## Appendix F Testing Standards, Design Standards and Engineering Calculations

This appendix contains listings of the Standards and Codes that were used in this Study and design parameters that were used for Engineering calculations and results of the Engineering Calculations.

## Appendix F Testing Standards, Design Standards and Engineering Calculations

### Part I Design Standards

This part contains a list of the applicable design standards and codes that were used in this Study.

## Design Standards

1. National Building Code 1985.
2. National Building Code 1980.
3. Alberta Building Code 1985.
4. Alberta Building Code 1980.
5. CAN3-086-M80 Code For Engineering Design in Wood.
6. CAN3-086.1-M84 Enginering Design in Wood (Working Stress Design)
7. CAN3-086-M84 Engineering Design in Wood (Limit States Design)
8. CAN3-S406-M83 CONSTRUCTION OF PRESERVED WOOD FOUNDATIONS.

## Appendix F Testing Standards, Design Standards. and Engineering Calculations

### Part II Testing Standards

The standards that were used for measuring moisture contents in the wood and the soil are listed on page F5.

## TESTING STANDARDS

1. ASTM D 2216-80 Standard Method for Laboratory Determination of water (moisture) content of the Soil, Rock and Soil-Aggregate Mixtures.

2. ASTM D 2016-74 (Reapproved 1984) Standard Test Methods for Moisture Content of Wood.

## Appendix F Testing Standards, Design Standards and Engineering Calculations

### Part III Design Parameters Used for Engineering Calculations in This Report.

The design parameters and the source of the design parameters are given on page F7 to F10.

DESIGN ASSUMPTIONS AND VALUES

| | CAN3 - S406 M83 | CAN3 - 086 M80 | CAN3 - 086 M84 | CAN3 - 086.1 M84 | VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT |
|---|---|---|---|---|---|
| 1.0 SOIL BEARING CAPACITY | 1562 PSF | 1562 PSF | 1562 PSF | 1565 PSF | 1562 PSF |
| 2.0 CLEAR SPANS FOR FLOORS | 16'-0" | 16'-0" | 16'-0" | 16'-0" | 16'-0" |
| 3.0 FLOOR LOADINGS (LIVE LOAD) | | | | | |
| .1 FIRST FLOOR AND SUSPENDED FLOOR | 39.6 PSF | 39.6 PSF | 39.6 PSF | 39.6 PSF | 39.6 PSF |
| .2 SECOND STOREY FLOOR | 29.2 PSF | 29.2 PSF | 29.2 PSF | 29.2 PSF | 29.2 PSF |
| .3 REDUCTION FACTOR | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |
| 4.0 FOUNDATION WALL HEIGHTS | | | | | |
| .1 SLAB FLOOR FOUNDATION | 7'-10 1/2" | 8'-0" | 8'-0" | 8'-0" | 8'-0" |
| .2 SUSPENDED WOOD FLOOR FOUNDATION | 9'-10" | 9'-10" | 9'-10" | 9'-10" | 9'-10" |
| 5.0 TOP OF GRANULAR LAYER TO TOP OF SUSPENDED FLOOR | 1'-11 5/8" | 2'-0" | 2'-0" | 2'-0" | 2'-0" |
| 6.0 LATERAL LOAD FROM SOIL PRESSURE: EQUIVALENT TO FLUID PRESSURE OF _____. | | | | | |
| .1 GRANULAR BACKFILL | 29.8 PCF | 29.8 PCF | 29.8 PCF | 29.8 PCF | 29.8 PCF |
| .2 STIFF CLAY BACKFILL | N/A | 44.5 PCF | 44.5 PCF | 44.5 PCF | 44.5 PCF |
| .3 SOFT CLAY BACKFILL | N/A | 99.7 PCF | 99.7 PCF | 99.7 PCF | 99.7 PCF |
| .4 MED CLAY BACKFILL | N/A | N/A | 75.0 PCF | 75.0 PCF | 75.0 PCF |
| 7.0 GROUND SNOW LOAD | 62.5 PSF | 62.5 PSF | 62.5 PSF | 62.5 PSF | 62.5 PSF |
| 8.0 BASIC SNOW LOAD COEFFICIENT | 0.6 | 0.6 | 0.6 | 0.6 | 0.6 |
| 9.0 BASIC LIVE LOAD REDUCTION FACTOR (Rpdl) | 0.8 | 0.8 | 0.8 | 0.8 | 0.8 |

DESIGN ASSUMPTIONS AND VALUES

| | CAN3 - S406 M83 | CAN3 - 086 M80 | CAN3 - 086 M84 | CAN3 - 086.1 M84 | VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT |
|---|---|---|---|---|---|
| 10.0 DEAD LOADS | | | | | |
| .1 ROOF | 10.4 PSF | 10.4 PSF | 10.4 PSF | 10.4 PSF | 10.4 PSF |
| .2 FLOOR | 9.8 PSF | 10.4 PSF | 10.4 PSF | 10.4 PSF | 9.8 PSF |
| .3 WALL (WITH STUDS) | 6.7 PSF | 6.7 PSF | 6.7 PSF | 6.7 PSF | 6.7 PSF |
| .4 WALL (WITH MASONRY VENEER) | 40.4 PSF | 40.4 PSF | 40.4 PSF | 40.4 PSF | 40.4 PSF |
| .5 FOUNDATION WALL | 5.6 PSF | 5.6 PSF | 5.6 PSF | 5.6 PSF | 5.6 PSF |
| .6 PARTITIONS | 4.2 PSF | 4.2 PSF | 4.2 PSF | 4.2 PSF | 4.2 PSF |
| 11.0 MODIFICATION FACTORS | | | | | |
| .1 LOAD DURATION (Kd) | 0.9 | 0.9 | 0.9 | 0.9 | 0.9 |
| .2 SIZE FACTOR (Kz) | N/A<br>N/A | N/A<br>N/A | 2*6=1.3<br>2*8=1.2 | 2*6=1.3<br>2*8=1.2 | 2*6=1.3<br>2*8=1.2 |
| .3 TREATMENT (Kt) | 1.0 | 1.0 | 1.0 | 1.0 | 1.0 |
| .4 LOAD - SHARING (Kh) | | | | | |
| BENDING | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 |
| SHEAR | 1.15 | 1.15 | 1.15 | 1.15 | 1.15 |
| COMPRESSION | 1.10 | 1.10 | 1.10 | 1.10 | 1.10 |
| .5 SERVICE CONDITIONS (Ks) | | | | | |
| BENDING | 0.84 | 1.0 | 1.0 | 1.0 | 1.0 |
| COMPRESSION | 0.69 | 1.0 | 1.0 | 1.0 | 1.0 |
| SHEAR | 0.96 | 1.0 | 1.0 | 1.0 | 1.0 |
| M.O.E | 0.94 | 1.0 | 1.0 | 1.0 | 1.0 |
| 12.0 ROOF LOADS ARE CARRIED TO THE EXTERIOR WALLS. | YES | YES | YES | YES | YES |

DESIGN ASSUMPTIONS AND VALUES

| | CAN3 - S406 MB3 | CAN3 - 086 MB0 | CAN3 - 086 MB4 | CAN3 - 086.1 MB4 | VALUES USED IN ENGINEERING CALCULATIONS IN THIS REPORT |
|---|---|---|---|---|---|
| 13.0 SPECIFIED STRENGTHS (SPF) | | | | | |
| .1 BENDING | | | | | |
| SELECT STRUCTURAL (Fb) | 1519 PSI | 1519 PSI | 1302 PSI | 2735 PSI | 2735 PSI |
| No. 1 (Fb) | 1288 PSI | 1288 PSI | 940 PSI | 1982 PSI | 1982 PSI |
| No. 2 (Fb) | 10[illegible] | 1056 PSI | 940 PSI | 1982 PSI | 1982 PSI |
| No. 3 (STUD) (Fb) | 593 PSI | 593 PSI | 694 PSI | 1461 PSI | 1461 PSI |
| .2 LONGITUDINAL SHEAR (Fv) | 67 PSI | 67 PSI | 67 PSI | 159 PSI | 159 PSI |
| .3 COMPRESSION-PARALLEL TO GRAIN | | | | | |
| SELECT STRUCTURAL (Fc) | 1143 PSI | 1143 PSI | 998 PSI | 1875 PSI | 1895 PSI |
| No. 1 (Fc) | 997 PSI | 997 PSI | 897 PSI | 1707 PSI | 1707 PSI |
| No. 2 (Fc) | 709 PSI | 709 PSI | 752 PSI | 1432 PSI | 1432 PSI |
| No. 3 (STUD) (Fc) | 434 PSI | 434 PSI | 449 PSI | 854 PSI | 854 PSI |
| .4 COMPRESSION-PERPENDICULAR TO GRAIN (Fcp) | 241 PSI | 241 PSI | 241 PSI | 463 PSI | 463 PSI |
| .5 MODULUS OF ELASTICITY | | | | | |
| SELECT STRUCTURAL (E) | 1346 KSI | 1346 KSI | 1606 KSI | 1606 KSI | 1606 KSI |
| No. 1 (E) | 1346 KSI | 1346 KSI | 1476 KSI | 1476 KSI | 1476 KSI |
| No. 2 (E) | 1215 KSI | 1215 KSI | 1476 KSI | 1476 KSI | 1476 KSI |
| No. 3 (STUD) (E) | 1085 KSI | 1085 KSI | 1403 KSI | 1403 KSI | 1403 KSI |
| 14.0 RESISTANCE FACTORS | | | | | |
| .1 BENDING MOMENT (Mr) | N/A | N/A | N/A | 0=0.7 | 0=0.7 |
| .2 COMPRESSION (Pr) | N/A | N/A | N/A | 0=0.75 | 0=0.75 |

DESIGN ASSUMPTIONS AND VALUES

| | CAN3 - S406 M83 | CAN3 - 086 M80 | CAN3 - 086 M84 | CAN3 - 086.1 M84 | Value Recommended By This Report |
|---|---|---|---|---|---|
| 15.0 LOAD FACTORS | | | | | |
| .1 DEAD LOAD ($\gamma_d$) | N/A | N/A | N/A | =1.25 | =1.25 |
| .2 LIVE LOAD ($\gamma_l$) | N/A | N/A | N/A | =1.50 | =1.50 |
| 16.0 FACTORS FOR INDIVIDUAL SPECIES | | | | | |
| .1 BENDING | | | | | |
| JACKPINE | N/A | 1.27 | N/A | N/A | N/A |
| LODGEPOLE PINE | N/A | 1.14 | N/A | N/A | N/A |
| WHITE SPRUCE | N/A | 1.00 | N/A | N/A | N/A |
| .2 COMPRESSION-PARALLEL TO GRAIN | | | | | |
| JACKPINE | N/A | 1.18 | N/A | N/A | N/A |
| LODGEPOLE PINE | N/A | 1.15 | N/A | N/A | N/A |
| WHITE SPRUCE | N/A | 1.00 | N/A | N/A | N/A |
| .3 MODULUS OF ELASTICITY | | | | | |
| JACKPINE | N/A | 1.04 | N/A | N/A | N/A |
| LODGEPOLE PINE | N/A | 1.12 | N/A | N/A | N/A |
| WHITE SPRUCE | N/A | 1.02 | N/A | N/A | N/A |

## Appendix F Testing Standards, Design Standards, and Engineering Calculations

### Part IV Maximum Backfill Heights

The table on page F12 contains the results of the calculations for maximum backfill heights.

1 CRITERI

-STUD TYPE = S-P-F UNLESS SHOWN OTHERWISE
-STUD HEIGHT = 8'-0"
-MAXIMUM BUILDING WIDTH PARALLEL TO JOISTS 10 32'-9 3/4"
-DESIGN LOADS AS PER CAN3-S406-M83
-ALLOWABLE STRESSES AND FACTORS AS PER GIVEN DESIGN STANDARD
-DRY SERVICE CONDITIONS ASSUMED FOR ALL STANDARDS (EXCEPT GIVEN HEIGHTS IN CAN3-S406-M83 ARE BASED ON WET SERVICE CONDITIONS)

## MAXIMUM BACKFILL HEIGHTS

S-P-F MATERIAL

| STUD SIZE | STUD SPACING | GRADE | CAN3 S406 M83 | CAN3-086-M80 S-P-F WHITE SPRUCE | CAN3-086-M80 S-P-F LODGEPOLE PINE | CAN3-086-M80 JACK PINE | CAN3-086-M84 S-P-F | CAN3 086.1 M84 S-P-F |
|---|---|---|---|---|---|---|---|---|
| 2 x 6 | 16"o.c. | SELECT STRUCTURAL | 5'-3" | 5'-8" | 6'-1" | 6'-4" | 6'-5" | 7'-2" |
| | | #1 | 4'-7" | 5'-3" | 5'-8" | 5'-11" | 5'-6" | 6'-3" |
| | | #2 | 4'-7" | 4'-8" | 5'-1" | 5'-3" | 5'-4" | 6'-1" |
| | | #3 STUD * | N/A | 3'-5" | 3'-9" | 3'-11" | 4'-3" | 4'-11" |
| 2 x 6 | 12"o.c. | SELECT STRUCTURAL | 6'-3" | 6'-7" | 7'-2" | 7'-6" | 7'-8" | 8'-4" |
| | | #1 | 5'-7" | 6'-2" | 6'-7" | 6'-11" | 6'-6" | 7'-0" |
| | | #2 | 5'-7" | 5'-6" | 5'-11" | 6'-2" | 6'-4" | 6'-10" |
| | | #3 STUD * | N/A | 4'-1" | 4'-5" | 4'-8" | 5'-2" | 5'-7" |
| 2 x 8 | 16"o.c. | SELECT STRUCTURAL | 6'-7" | 7'-7" | 8'-3" | 8'-9" | 8'-6" | 9'-8" |
| | | #1 | 6'-3" | 7'-0" | 7'-7" | 8'-0" | 7'-0" | 8'-0" |
| | | #2 | 6'-3" | 6'-2" | 6'-8" | 7'-1" | 7'-0" | 7'-10" |
| | | #3 STUD * | N/A | 4'-7" | 4'-11" | 5'-10" | 5'-7" | 6'-5" |
| 2 x 8 | 12"o.c. | SELECT STRUCTURAL | NOT GIVEN | 9'-1" | 10'-0" | 10'-9" | 10'-5" | 12'-2" |
| | | #1 | NOT GIVEN | 8'-4" | 9'-0" | 9'-8" | 8'-6" | 9'-4" |
| | | #2 | NOT GIVEN | 7'-4" | 7'-11" | 8'-5" | 8'-4" | 9'-2" |
| | | #3 STUD * | N/A | 5'-5" | 5'-10" | 6'-1" | 6'-9" | 7'-4" |

## Appendix F Testing Standards, Design Standards and Engineering Calculations

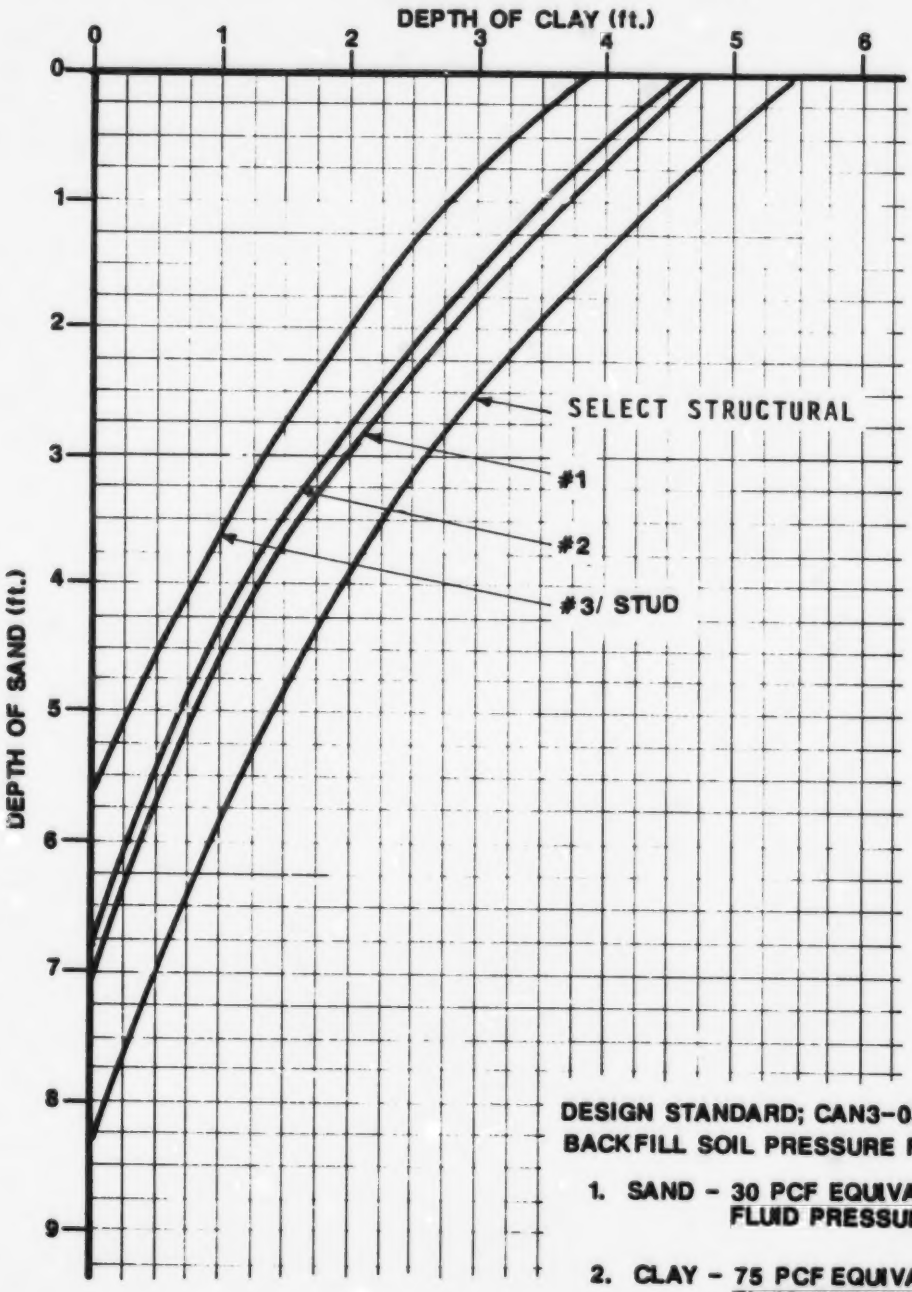
### Part V Combined Backfill Charts

The charts on pages F13 to F16 contain plots of Clay depth vs Sand depth and curves of equal deflection or equal bending moment.

THE TABLES IN THIS SECTION ARE NOT TO BE USED FOR DESIGN PURPOSES. A REVISED CAN3-086 IS CURRENTLY BEING PUBLISHED AND THE CURVES WILL CHANGE.

## COMBINED BACKFILL
## CLAY OVER SAND

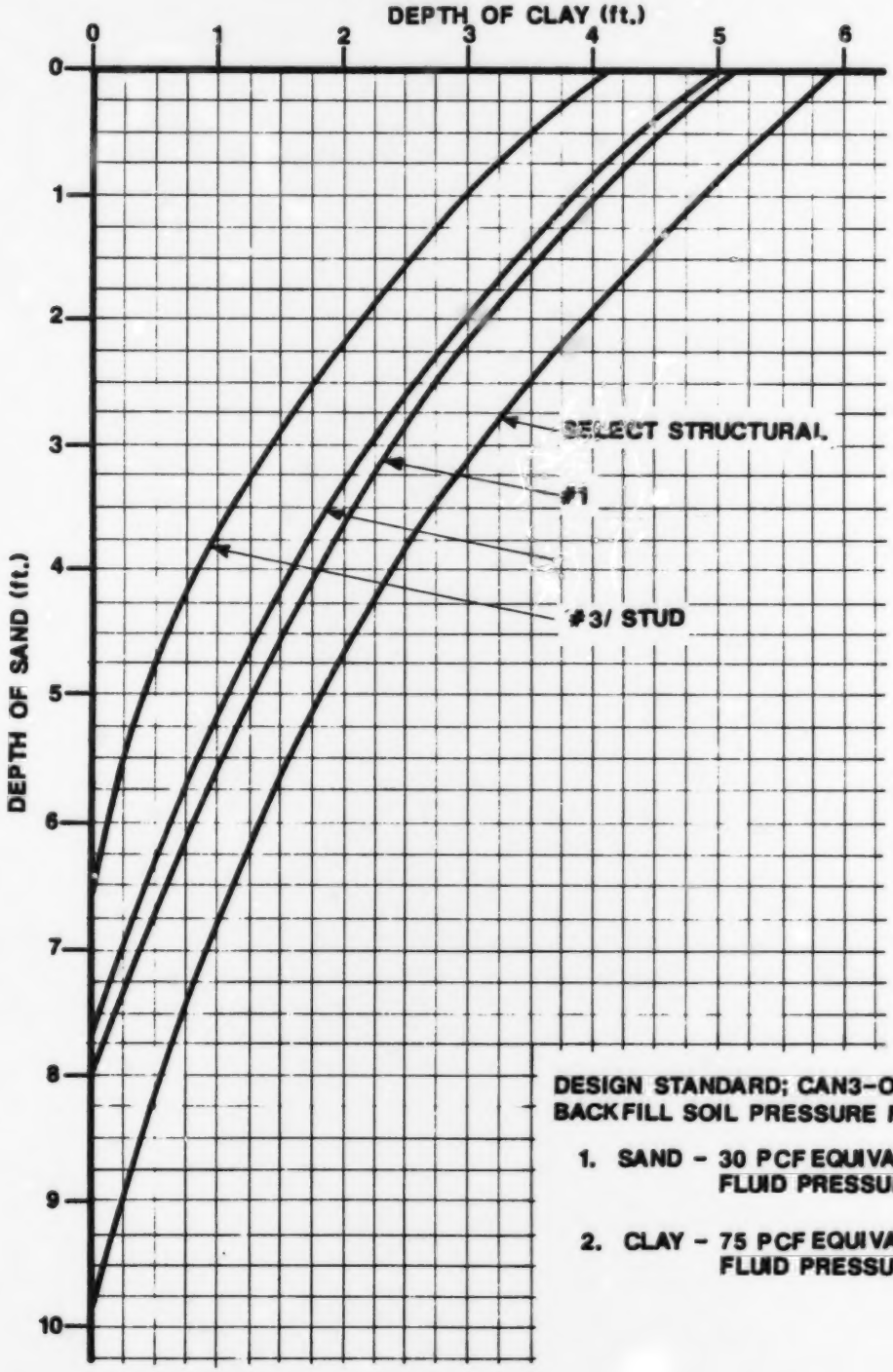
### 2"x6" S-P-F @ 12" o.c.




**DESIGN STANDARD; CAN3-086.1-M84**
**BACKFILL SOIL PRESSURE FACTORS:**

1. **SAND - 30 PCF EQUIVALENT FLUID PRESSURE**
2. **CLAY - 75 PCF EQUIVALENT FLUID PRESSURE**

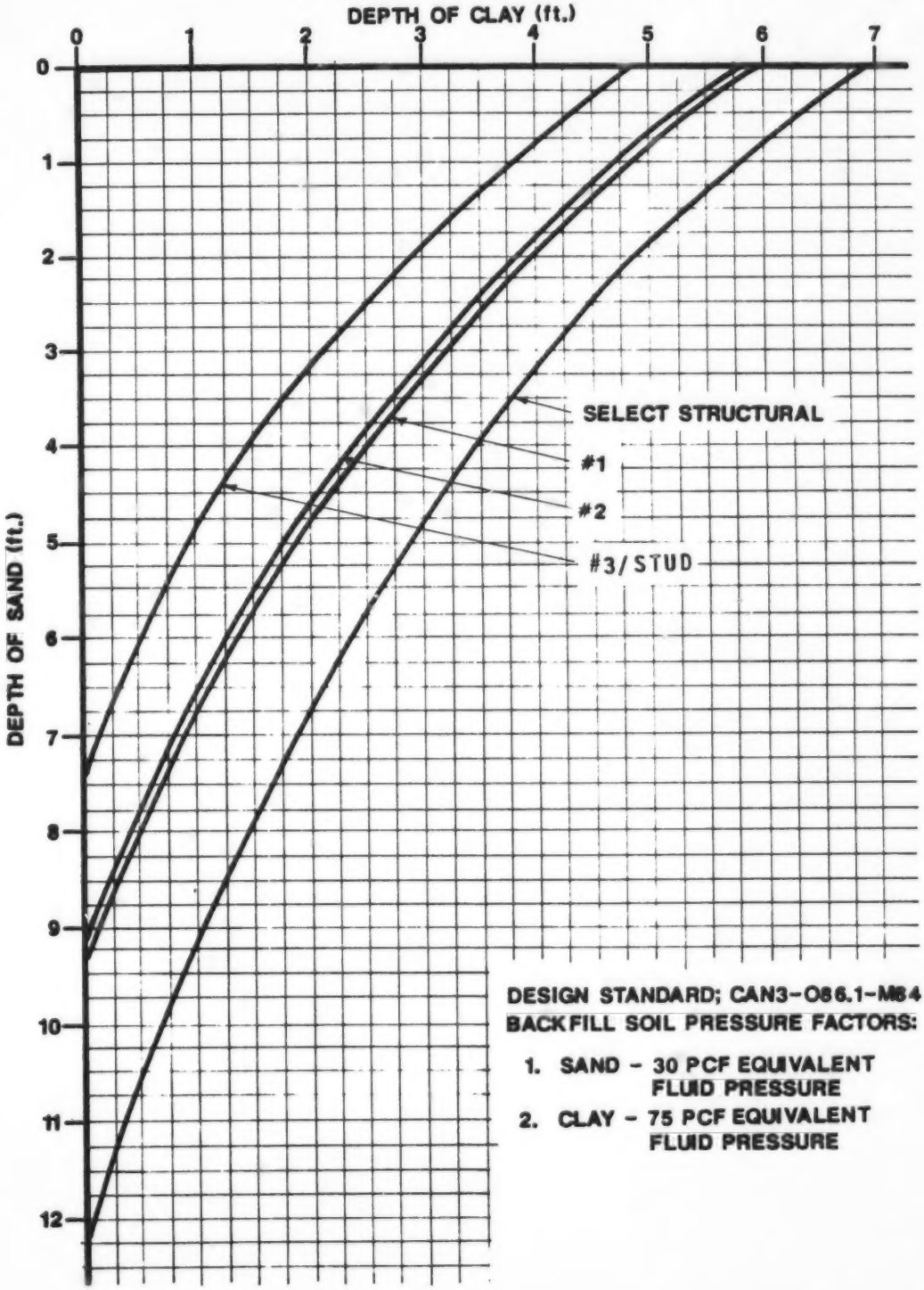
## COMBINED BACKFILL
### CLAY OVER SAND
### 2"x8" S-P-F @ 16" o.c.




DESIGN STANDARD; CAN3-O86.1-M84
BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE
2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

# COMBINED BACKFILL
## CLAY OVER SAND
### 2"x8" S-P-F @ 12" o.c.



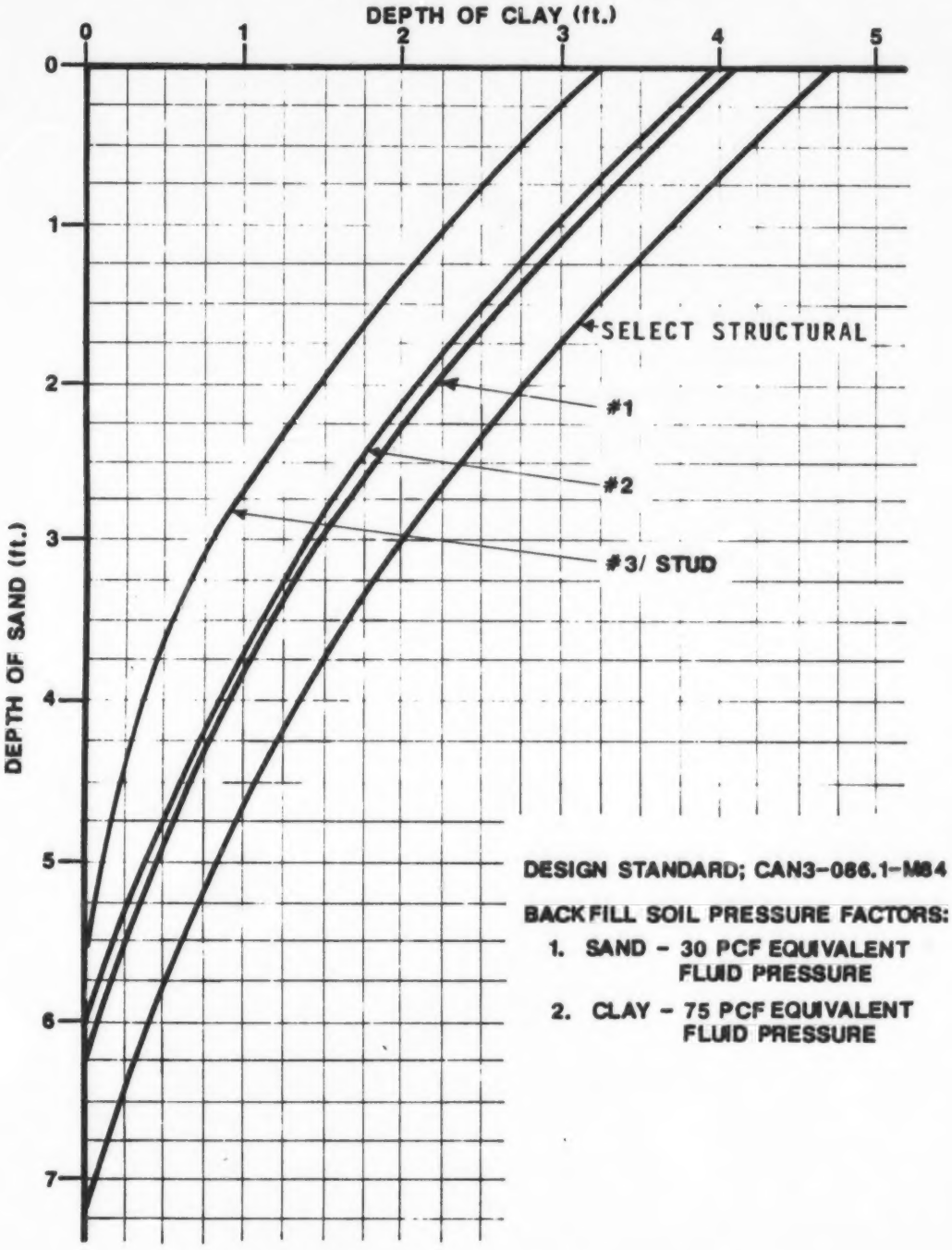

DESIGN STANDARD; CAN3-O86.1-M84

BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE
2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

# COMBINED BACKFILL
## CLAY OVER SAND

### 2"x6" S-P-F @ 16" o.c.




DESIGN STANDARD; CAN3-086.1-M84

BACKFILL SOIL PRESSURE FACTORS:

1. SAND - 30 PCF EQUIVALENT FLUID PRESSURE
2. CLAY - 75 PCF EQUIVALENT FLUID PRESSURE

## Appendix G Glossary of Terms

| | | |
|---|---|---|
| ACA | - | is the trade or industrial abbreviation for Ammonical Copper Arsenate, one of the two chemicals approved for treating PWF material. |
| Base Plate | - | it is the plate or the 2" dimensional lumber at the bottom of the studs in the wall. |
| Cap Plate | - | it is the plate or the 2" dimensional lumber directly on top of the top plate. |
| CCA | - | is the trade or industry abbreviation for Chromated Copper Arsenate, one of the two chemicals approved for treating PWF material. |
| Combined Drainage | - | this includes both negative and positive drainage situations. |
| Drainage Rock Layer | - | this is a layer of rock that is placed below the floor of the basement. |
| Equivalent Fluid Pressure | - | the backfill material places pressure on the wall, when this pressure is equated to a fluid pressure the resulting number is the equivalent fluid pressure. |
| Exterior Stud | - | it is a PWF stud in the exterior wall of the foundation. |
| Footing Plate | - | it is the plate or the 2" dimensional lumber below or under the base plate. |
| Grade | - | it is the level of the backfill on the exterior of the PWF wall. |
| L/180 deflection | - | the deflection is the length divided by 180. |
| Moisture Content | - | is the ratio of the weight of the water or moisture in the wood divided by the dry weight of the wood. |
| Negative Drainage | - | this occurs when the backfill is horizontal or it slopes towards the house. |
| Permeability | - | the ease with which water can pass through a material. |

| | | |
|---|---|---|
| Positive Drainage | - | this occurs when the backfill slopes away from the house. |
| PWF | - | preserved wood foundation. |
| S-P-F | - | this is a categorey of woods that includes Spruce, Pine and Fir species. |
| Top Plate | - | it is the plate or the 2" dimensional lumber directly on top of the wall stud. |